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Takotna River Salmon Studies, 2006

Annual Report for Study 05-304
USFWS Office of Subsistence Management
Fisheries Information Services Division and
Bering Sea Fishermen's Association

by

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Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat. or long.
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Measures (fisheries)

fork length	FL
mideye-to-fork	MEF
mideye-to-tail-fork	METF
standard length	SL
total length	TL

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	$\log_2$, etc.
minute (angular)	'
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	"
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

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The Division of Sport Fish Fishery Data Series was established in 1987 for the publication of technically oriented results for a single project or group of closely related projects. Since 2004, the Division of Commercial Fisheries has also used the Fishery Data Series. Fishery Data Series reports are intended for fishery and other technical professionals. Fishery Data Series reports are available through the Alaska State Library and on the Internet: http://www.sf.adfg.state.ak.us/statewide/divreports/html/intersearch.cfm This publication has undergone editorial and peer review.

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ABSTRACT

The Takotna River is a major tributary of the Kuskokwim River that currently supports modest runs of Pacific salmon *Oncorhynchus spp.* compared to other tributaries in the drainage. The Takotna River weir is one of several projects operated in the Kuskokwim Area that form an integrated geographic array of escapement monitoring projects. Collectively, and in accordance with the State of Alaska's Policy for the Management of Sustainable Salmon Fisheries (5 AAC 39.222), this array of projects is a tool to ensure appropriate geographic and temporal distribution of spawners, and provide a means to assess trends in escapement that should be monitored and considered in harvest management decisions. Towards this end, Takotna River weir has been operated annually since 2000 to determine daily and total salmon escapements for the target operational period of 24 June through 20 September; to estimate age, sex, and length compositions of Chinook, chum, and coho salmon escapement; to monitor environmental variables that influence salmon productivity; to investigate geographic distribution and length patterns of juvenile Chinook and coho salmon in the Takotna River drainage; and to provide part of an integrated platform in support of other Kuskokwim Area fisheries projects.

In 1995, the Alaska Department of Fish and Game (ADF&G) established an escapement monitoring program on the Takotna River approximately 835 river kilometers (rkm) from the mouth of the Kuskokwim River. A counting tower was used to enumerate fish from 1995 to 1999 with limited success, and the project transitioned to a resistance board weir in 2000. Since its inception, the weir has been jointly operated by ADF&G Division of Commercial Fisheries and the Takotna Tribal Council (TTC). Historically, the Takotna River weir has enjoyed an excellent performance record, and in 2006 it suffered only one brief inoperative period from 19 to 22 August. Total annual escapement for the 2006 target operational period included 539 Chinook *O. tshawytscha*, 12,598 chum *O. keta*, and 5,548 coho *O. kisutch*. A total of 60 sockeye salmon *O. nerka* and 1 pink salmon *O. gorbuscha* were also observed passing upstream of the weir in 2006. Age, sex, and length (ASL) samples were obtained from 49.9% of the Chinook escapement, 9.3% of the chum escapement, and 7.8% of the coho escapement. The Chinook salmon escapement consisted of 42.4% age-1.2 fish, 30.2% age-1.3 fish, 23.1% age-1.4 fish, and 23.3% females. The chum salmon escapement consisted of 62.2% age-0.3 fish, 35.5% age-0.4 fish, 2.2% age-0.2 fish, and 46.9% females. The coho salmon escapement consisted of 93.2% age-2.1 fish, 3.4% of age-1.1 fish, 3.4% of age-3.1 fish, and 45.0% females. Sampling to investigate the distribution of juvenile salmon in the Takotna River was conducted in Moore and Minnie creeks, Little Waldren Fork, and in the main stem of the Takotna River between Fourth of July Creek and Big Waldren Fork. No juvenile salmon were captured in these locations, precluding analyses of spatial and temporal length patterns. In addition to enumerating escapement, estimating ASL composition, and investigating juvenile salmon distribution, the weir served as a platform for several other projects including *Inriver Abundance of Chinook Salmon in the Kuskokwim River* (FIS 05-302), *Kuskokwim River Sockeye Salmon Investigations,* and *Kuskokwim River Salmon Mark–Recapture Project* (FIS 04-308). The Takotna River weir successfully contributed to each of these projects in 2006.

Key words: Kuskokwim River, Takotna River, escapement, Chinook salmon, *Oncorhynchus tshawytscha*, chum salmon, *O. keta*, coho salmon, *O. kisutch*, juvenile salmon, resistance board weir, upper Kuskokwim, age-sex-length, ASL, radiotelemetry, mark–recapture, stock specific run timing.

INTRODUCTION

The Kuskokwim River is the second largest river in Alaska, draining an area approximately 130,000 km^2 (Figure 1; Brown 1983). Each year mature Pacific salmon *Oncorhynchus spp.* return to the river and its tributaries to spawn, supporting an annual average subsistence and commercial harvest of nearly 1 million salmon (Whitmore et al. 2005). The subsistence salmon fishery in the Kuskokwim Area is one of the largest and most important in the state (ADF&G 2003; Coffing 1991; Coffing et al. 2001; *Unpublished* a, b; Ward et al. 2003; Whitmore et al. 2005) and remains a fundamental component of local culture. The commercial salmon fishery, though modest in value compared to other areas of Alaska, has been an important component of the market economy of lower Kuskokwim River communities (Buklis 1999; Whitmore et al. 2005). Salmon that contribute to these fisheries spawn and rear in nearly every tributary of the Kuskokwim River basin.

Since 1960, management of Kuskokwim River subsistence, commercial, and sport fisheries has been the responsibility of the Alaska Department of Fish and Game (ADF&G). Management authority for the subsistence fishery was broadened in October 1999 to include the federal government under Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA). The U.S. Fish and Wildlife Service (USFWS) is the federal agency most involved within the Kuskokwim Area. In addition, tribal groups such as the Takotna Tribal Council (TTC) are charged by their constituency to actively promote a healthy and sustainable subsistence salmon fishery. These and other groups have combined their resources to develop projects such as the Takotna River weir to better achieve the common goal of providing for long-term sustainability of salmon fisheries in the Kuskokwim River.

The goal of salmon management is to provide for long-term sustainable fisheries by ensuring that adequate numbers of salmon escape to the spawning grounds each year. This goal requires an array of long-term escapement monitoring projects that reliably measure annual escapement to key spawning systems as well as track temporal and spatial patterns in abundance that influence management decisions. Over time and with sufficient data, escapement goals can be developed as a means to gauge escapement adequacy, but current spawner-recruit models for escapement goal development require several years of data. In the Kuskokwim River, only two long-term, ground-based escapement monitoring projects have operated reliably for more than 10 years (Whitmore et al. 2005). Of the dozens of tributaries known to support spawning populations of salmon, the presence of escapement-monitoring projects on only two clearly does not provide adequate escapement information for the entire Kuskokwim River basin. This deficiency was improved when several additional projects were initiated in the mid-to-late 1990s, including the Takotna River weir. The data provided by the current array of projects have much greater utility for fishery managers and decreased their reliance on aerial stream surveys which are known to be less reliable (Whitmore et al. 2005). Annual escapement monitoring in the Takotna River, coupled with other initiatives begun in the late 1990s and beyond (Kerkvliet et al. 2003; Schwanke et al. 2001; Stroka and Brase 2004; Stuby 2003), provides some of the additional escapement monitoring and abundance estimates required for management authorities to assess the adequacy of escapements and the effectiveness of management decisions (Holmes and Burtkett 1996; Mundy 1998).

In recent years, Kuskokwim River Chinook *O. tshawytscha* and chum *O. keta* salmon have received considerable attention by the Alaska Board of Fisheries (BOF) due to erratic run abundance patterns. The BOF designated Kuskokwim River Chinook and chum salmon as "stocks of yield concern" in 2000 due to the chronic inability of managers to maintain expected harvest levels (Burkey et al. 2000a, b; Ward et al. 2003). This "stock of yield concern" designation was upheld during the 2004 BOF meeting but was cancelled during the 2007 BOF meeting at the recommendation of ADF&G following several years of expected harvest levels and relatively strong escapements (Bergstrom and Whitmore 2004; Molyneaux and Brannian 2006). Between 2001 and 2006 subsistence and commercial fisheries were managed conservatively and conducive to the BOF "stocks of yield concern" designations. Efforts were focused on enumerating abundance of these species and obtaining enough data for escapement goal development. Several main-river and regional projects arose that utilized the existing weir infrastructure for data collection. Such projects have since become deeply integrated components of field operations.

Although salmon production is modest, the Takotna River contributes to sustainable fisheries both by adding to the annual production and by adding to genetic diversity similar to what Hilborn et al. (2003) described for Bristol Bay. Since fishers tend to harvest fish from the early part of the salmon runs and the early part of the runs may be dominated by upper river salmon stocks, salmon production from the upper Kuskokwim River may support a disproportionately high fraction of the subsistence harvest, particularly for Chinook salmon. This latter point makes monitoring upper Kuskokwim River salmon escapements, such as on the Takotna River, a particularly important tool for maintaining long-term sustainability of the downriver fisheries (Burkey et al. 2000a; Kerkvliet et al. 2003, Kerkvliet et al. 2004; Pawluk et al. 2006a, 2006b; Stuby *In prep*).

The utility of weirs extends beyond providing annual escapement estimates. Escapement projects, such as the Takotna River weir, commonly serve as platforms for collecting other types of information useful for management and research. Collection of age, sex, and length (ASL) data are typically included in most escapement monitoring projects, and the Takotna River weir is no exception (Molyneaux and Folletti *In prep*). Knowledge of ASL composition can provide insights into understanding fluctuations in salmon abundance and is essential in developing spawner-recruit relationships used in formulating escapement goals (DuBois and Molyneaux 2000). The Takotna River weir also serves as a platform for collecting information on habitat variables. Water temperature, water chemistry, and stream discharge (level) are fundamental variables of the stream environment that directly or indirectly influence salmon productivity and timing of salmon migrations (Hauer and Hill 1996; Kruse 1998; Quinn 2005). Since these variables can be affected by human activities (i.e., mining, timber harvesting, man-made impoundments, etc.; NRC 1996) or climatic changes (e.g., El Nino and La Nina events), data collection for such variables are included in the project operational plan.

BACKGROUND

The Takotna River currently supports modest runs of Chinook, chum, and coho *O. kisutch* salmon, which are thought to be vestiges of much stronger runs. Small escapements of sockeye salmon *O. nerka* have also been observed in the Takotna River in recent years. Takotna River salmon populations appear to be in a state of recovery following near extirpation in the early twentieth century (Molyneaux et al. 2000; Stokes 1985). Prior to the early 1900s, native Athabaskans in the area harvested salmon from the Takotna River. This included residents of Tagholjitdochak', a village located on the Takotna River near the confluence of Fourth of July Creek (Figure 2; Anderson 1977; BLM 1984; Hosley 1966; Stokes 1985). Hosley (1966) and Stokes (1983) reported that people from the Vinasale and Tatlawiksuk Athabaskan bands also fished in the Takotna River. The numbers of salmon these groups harvested is unknown, but interviews with Nikolai elders recall the existence of fairly strong Chinook and chum salmon runs in the Takotna River until the early 1900s (Stokes 1985).

Historically, native Athabaskans commonly harvested salmon using weirs fitted with fish traps. At least four historical weir sites have been documented on the Takotna River; the last of these was abandoned no later than the mid 1920s, according to oral history and firsthand knowledge of Nikolai elders (Figure 2; Stokes 1983). One of the weir sites was located on the Nixon Fork of the Takotna River, near the confluence of the West Fork River. The other locations included a site on the main river a short distance above the community of Takotna, one near Big Creek (lower), and another near or within Fourth of July Creek. According to an elder who fished the Nixon Fork weir, these sites were abandoned as a result of the booming mining industry, which inspired a general migration to major village sites, and rapid population decline during several epidemics that ravaged area Native populations in the late nineteenth and early twentieth centuries. In many cases, residents that survived the wave of epidemics, primarily diphtheria, were forced to abandon traditional village sites such as at Tagholjitdochak' between 1908 and 1910 (BLM 1984).

Gold was discovered in the Innoko mining district in 1906 and the Takotna River became a major access route to the gold fields (Brown 1983). The community of Takotna developed as a supply point and staging area for miners. Dog teams were the primary means of winter transportation and the dried salmon they were fed were likely harvested from the Takotna River and other local streams. Steamboats loaded with tons of mining supplies navigated the Takotna River as far upstream as the current town of Takotna. In the early 1920s, small temporary dams were built on the river to facilitate steamboat passage (Kusko Times 1921). At some point, salmon populations became depleted. The timing and cause of the decline are unclear (Stokes 1985), but was likely caused by a combination of overfishing and habitat alteration associated with mining development.

Area residents and local biologists described the Takotna River as being nearly void of salmon during the 1960s and 1970s (Molyneaux et al. 2000). By the 1980s, Takotna residents began to notice adult salmon in the river again. During an aerial survey in 1994, an experienced ADF&G fishery biologist observed several thousand chum salmon and some Chinook salmon in Fourth of July Creek, a clear water tributary of the Takotna River, but few salmon were observed elsewhere in the Takotna drainage (Burkey and Salomone 1999). By about 1990, rod and reel fishers began to catch coho salmon while fishing for northern pike *Esox lucius* (Dick Newton, local resident, Takotna; personal communication).

Due to its location, size, and a perceived increase in salmon abundance, an escapement monitoring program was implemented on the Takotna River in 1995. A counting tower was used to enumerate fish from 1995 to 1999, but success was limited because of poor water clarity, periodic high water levels, and organizational difficulties (Molyneaux et al. 2000). As one of several initiatives that were started in the late 1990s to help address the information gaps in the management program, the escapement monitoring program on the Takotna River transitioned from a counting tower to a resistance board weir in 2000 (Clark and Molyneaux 2003; Costello et al. 2005; Costello et al. 2006; Gilk and Molyneaux 2004; Schwanke et al. 2001; Schwanke and Molyneaux 2002). The Takotna River weir is currently the farthest upstream ground-based salmon escapement-monitoring project in the Kuskokwim River drainage. The use of the weir greatly enhanced the success of the program.

The ADF&G Division of Commercial Fisheries and the Takotna Tribal Council (TTC) jointly operate the weir. Staff from ADF&G helps oversee inseason operations and serve as the principal agent for data management, data analysis, and report writing. The TTC provides most of the field crew and coordinates much of the preseason preparations and inseason operations.

OBJECTIVES

The annual objectives of the Takotna River escapement monitoring project (FIS 05-304) were to:

1. Determine daily and total annual escapements of male and female Chinook, chum, and coho salmon in the Takotna River upstream of the community of Takotna during the target operational period of 24 June to 20 September;
2. Estimate the age, sex, and length (ASL) composition of total annual Chinook, chum, and coho salmon escapements from a minimum of 3 pulse samples, 1 collected from each third of the run, such that 95% simultaneous confidence intervals for the age composition in each pulse are no wider than 0.20 (α = 0.05 and d = 0.10);
3. Monitor habitat variables and determine possible effects of water level and water temperature on salmon migration past the weir;
4. Search for the presence of juvenile salmon in Takotna River tributaries not frequently investigated to assess their utilization of these areas; and,
5. Provide for collaborative, efficient research in the Kuskokwim River system by:
    a. Serving as a monitoring location for Chinook salmon equipped with radio transmitters deployed as part of *Inriver Abundance of Chinook Salmon in the Kuskokwim River* (FIS 05-302);
    b. Serving as a monitoring location for sockeye salmon equipped with radio transmitters deployed as part of *Kuskokwim River Sockeye Salmon Investigations*; and; and
    c. Serving as a recovery location for tagged Chinook and sockeye salmon in support of *Kuskokwim River Salmon Mark–Recapture Project* (FIS 04-308).

The primary goal of this report is to summarize and present the results for the 2006 field season at the Takotna River weir. Secondary to this, we intend to provide a more holistic perspective of Kuskokwim Area fisheries by placing the 2006 findings into the broader spatial and temporal context. To do this we draw heavily on data from past years at this project to highlight between year trends, and we draw on data from other escapement monitoring projects, related research projects, and the commercial and subsistence fishery in order to highlight spatial trends. These goals are intended to enhance the utility of this report beyond simply archiving data. It is important to note that some of the data used to make these broader comparisons are preliminary. Effort was made to ensure that all preliminary data was reported as such. In addition, many of the referenced documents are currently being developed. Consequently, most of the reported trends for other projects were determined by the authors of this report based on finalized data sets generously provided by other researchers. At the time of publication of this document all reported estimates and trends are as accurate as possible; however, the final results and conclusions for "*In prep*" documents may change. This highlights the importance for readers to consult the original documents prior to referencing results from other projects. Furthermore, unless stated, the statistical significance of the trends discussed for this and other escapement monitoring projects have not been determined. Many of these trends are subjective and based on low sample sizes with high variance. It is important to remember that sampling methodologies often differ across projects and over time leading to difficulty in comparisons. Throughout this document every effort was made to ensure sound comparisons; however, the reader should be aware of these potential issues and receive broader spatial and temporal trends with caution.

METHODS

STUDY AREA

The Takotna River originates in the central Kuskokwim Mountains of the upper Kuskokwim River basin (Figure 1). Formed by the confluence of Moore Creek and Little Waldren Fork, the river flows northeasterly, passing the community of Takotna at river kilometer (rkm) 80, before turning southeasterly near the confluence of the Nixon Fork at rkm 24 (Figure 2; Brown 1983). The Tatalina River joins at rkm 4.8, and then the Takotna River empties into the Kuskokwim River across from McGrath at rkm 752 of the Kuskokwim River.

The Takotna River is about 160 km in length and drains an area of 5,646 sq km (Brown 1983). The river is shallow with many meanders from its headwaters to the community of Takotna, but gradually becomes deeper downstream of that point, especially after the confluence of the Nixon Fork. In the lower reaches, the current is sluggish and the channel width averages 122 to 152 m. The river’s average slope is about 89 cm per km (Brown 1983).

At normal flow the Takotna River has a nominal load of suspended materials, but the water is stained due to organic leaching. The Nixon Fork and Tatalina rivers drain extensive bog flats and swampy lowlands, but the remainder of the basin is primarily upland spruce-hardwood forest (Brown 1983; Selkregg 1976). White spruce, birch, and aspen are common on moderate south-facing slopes, while black spruce is more characteristic of northern exposures and poorly drained flat areas. The understory consists of spongy moss and low brush on the cool, moist slopes, grasses on the dry slopes, and willow and alder in the higher open forest near the timberline.

WEIR DESIGN

Installation Site

The weir was installed in 2006 at the same location used in previous years, which is approximately 185 m upstream of the Takotna River Bridge (Costello et al. 2006). The site was about 3 rkm upstream of the village of Takotna and 83 rkm from the confluence with the Kuskokwim River (Figure 2). The weir is located downstream from most known spawning areas, so the project provides a nearly complete census of salmon escapement in the Takotna River excluding the Nixon Fork and Tatalina rivers.

At the weir site, the Takotna River is approximately 85 m wide and 4 m deep from bank level to the bottom of the channel. During normal summer operations, river depth is about 1 m in the deepest section. The weir is positioned in the center of a 1 km stretch of relatively straight channel, with a large floodplain to the south. Vegetation on the floodplain is mostly grasses with interspersed patches of alder and willow, which suggests that it is in an intermediate stage of succession.

Construction

The design and materials used in the Takotna River weir in 2006 were the same as those used in 2000 (Schwanke et al. 2001), and included modifications incorporated into the design in 2001 (Schwanke and Molyneaux 2002). The weir was installed across the entire 85-m (280-ft) channel following the techniques described by Stewart (2003). The substrate rail and resistance board panels covered the middle 79-m (260-ft) portion of the channel, and fixed weir materials extended the weir 3 m (10 ft) to each bank. The pickets were 1-5/16 in (3.33 cm) in diameter and spaced at intervals of 3 in (7.62 cm) to leave a gap of 1-11/16 in (4.29 cm) between each picket. Stewart (2002, 2003) describes details of panel construction and installation.

A live trap was installed within the deeper portion of the channel. Designed as the primary means of upstream fish passage, the trap could be easily configured to pass fish freely upstream, capture individual fish for tag recovery, or trap numerous fish for collection of ASL or genetic samples. Schwanke et al. (2001) describes the details of trap construction and installation.

Installation of 2 skiff gates allowed boats to pass with little or no involvement from the weir crew. Both skiff gates consisted of the same modified weir panels described by Schwanke et al. (2001), but 1 gate was modified to accommodate propeller-driven boats. Boats with jet-drive engines were the most common and could pass up or downstream over the primary skiff gate after reducing their speed to 5 miles per hr (8 km per hr) or less. Operators of propeller-driven boats could pass upstream and downstream over the modified boat gate described by Costello et al. (2005).

To accommodate downstream migration of longnose suckers *Catastomas catostomas* and other resident species, downstream passage chutes were incorporated into the weir once resident species were observed congregating just upstream. At locations where downstream migrants were most concentrated, chutes were created by releasing the resistance boards on 1 or 2 adjacent weir panels so the distal ends dipped slightly below the stream surface. The chute's shallow profile guided downstream migrants while preventing upstream salmon passage. The chutes were monitored and adjusted to ensure salmon were not passing upstream over them. Downstream passage was not enumerated, however, few salmon have typically been observed passing downstream over these chutes, and these numbers are not considered significant.

Maintenance

The weir was cleaned twice each day, typically at the end of the morning and evening counting shifts. A technician walked across the weir partially submerging each panel, allowing the current to wash any debris downstream. Algal growth and debris that accumulated around stringers was periodically removed either with a rake or by hand. Each time the weir was cleaned, the weir panels, substrate rail, fish trap, and fixed weir sections were inspected for signs of substrate scouring, broken pickets, or other conditions that could allow fish to pass without detection. Periodically, the crew conducted a more thorough inspection by snorkeling along the substrate rail. Any points along the substrate rail showing signs of substrate scouring were immediately addressed with sandbags. Damaged weir pickets were repaired using wooden dowels as described by Stewart (2002).

Escapement Monitoring

The target operational period for the weir is 24 June to 20 September, although actual operational periods may vary from year to year. Total annual escapement is defined as the number of fish that passes within this period. In years when the operational period falls short of the target operational period, or when there are inoperable periods during the season, estimates of the daily salmon passage are made for missed days in order to provide consistent comparisons of escapements among years. Total annual escapement is determined from the total observed and estimated fish passage.

Passage Counts

In 2006, all fish passing upstream of the weir through the passage gates were counted and recorded by species and sex, excluding fish that were small enough to pass freely between the weir pickets. Standard daily operations consisted of four 2-hour counting periods, but this schedule was adjusted as needed to accommodate the migratory behavior and abundance of fish, or operational constraints such as reduced visibility in evening hours late in the season. Substantial delays in fish passage occurred only at night or during intensive ASL sampling. Crew members recorded the total upstream fish count, plus any additional information such as weather observations, tags, and carcass counts, on a designated form and zeroed the tally counter after each counting session. At the end of each day, total daily and cumulative seasonal counts were copied to logbook forms. These counts were reported each morning to ADF&G staff in Bethel via telephone or email.

The live trap was used as the primary means of upstream fish passage so crew members could capture and recover information from fish tagged in the mainstem Kuskokwim River. A Plexiglas®[1] viewing window was placed on the stream surface to improve visual identification of fish entering the trap. This allowed passage counts to be conducted from the downstream entrance of the trap, and enabled crew members to observe and capture tagged fish. A secondary passage gate could be employed if fish were hesitant to enter the live trap. Using the trap as a counting platform, a connecting picket would be removed between 2 neighboring panels. By folding the panels to stand on edge, an opening 6 feet wide would be created. A rigid aluminum weir panel would be lashed to the upstream ends of the panels to serve as an easily removable gate. When removed for counting, the gate would be placed on the river bottom, in front of the opening, to act as a flash panel for the identification of passing fish. Alternatively, a weir panel could be removed from anywhere along the weir, and a crew member could wade next to the opening to conduct a passage count.

Visual determination of sex was possible due to advanced sexual dimorphism. For example, females became obviously swollen and round behind the pectoral fins, had blunt, bullet-shaped heads, and swam with steady, wide strokes. Males exhibited an exaggerated elongation of the kype, were streamline and muscular in appearance, and swam with short, powerful strokes. Though some variation exists, these differences were applicable to all salmon species observed. The above mentioned viewing box greatly improved identification, although the presence of a flash-panel on the river bottom was usually sufficient for making these determinations.

Estimating Missed Passage

To allow comparison among years, upstream salmon passage was estimated in 2006 for days when the weir is inoperable during the target operational period. At this project, three methods for estimating missed passage are consistently used every year when required, but which method chosen depends on the duration and timing of the inoperable periods.

[1] Product names used in this report are included for scientific completeness but do not constitute a product endorsement.

Single Day Method

Passage estimates for a single day are calculated as the average of the observed passage for 2 days before and 2 days after the inoperable day. On the occasions when the weir was inoperative for only part of 1 day or a hole was discovered in the weir, estimates of missed passage are generated using the single day method minus any observed passage from the compromised day.

Linear Method

When adequate data exist before and after an inoperable period, a "linear method" is used to interpolate daily estimates from average observed passage 2 days before an inoperable period to average observed passage 2 days after the inoperable period. This method results in a linear increase or decrease in daily passage estimates over the duration of the inoperable period. Daily estimates from this method are calculated using the formula:

$$\hat{n}_{d_i} = \alpha + \beta \cdot i \tag{1}$$

$$\alpha = \frac{n_{d_1-1} + n_{d_1-2}}{2}$$

$$\beta = \frac{\left(n_{d_I+1} + n_{d_I+2}\right) - \left(n_{d_1-1} + n_{d_1-2}\right)}{2\left(I+1\right)}$$

for (d_1, 2, …, d_i, …d_I)

where

$\hat{n}_{d_i}$ = passage estimate for the i^{th} day of the period (d_1, 2, …, d_i, …d_I) when the weir was inoperative,

n_{d_I+1} = observed passage the first day after the weir was reinstalled,

n_{d_I+2} = observed passage the second day after the weir was reinstalled,

n_{d_1-1} = observed passage of 1 day before the weir was washed out,

n_{d_1-2} = observed passage of the second day before the weir was washed out, and

I = number of inoperative days.

Proportion Method

For meaningful comparisons among years it is imperative that escapement is determined for the entire target operational period. On the occasions that weir operation is delayed beyond the target start date, or is terminated before the target end date, daily passage estimates are required to for the remaining days of the target operational period. In these situations, adequate data do not exist to estimate passage using the linear method; instead, estimates are derived using a model data set. A data set may be selected as a model if it exhibits fish passage characteristics similar to known passage at the Takotna River weir. The model data set used could be from a different year at the Takotna River weir or from a neighboring project during the same year. In either case, daily passage is based on a model data set's daily passage proportions, and is calculated using the formula:

$$n_{d_i} = \left(\frac{\left(n_{2d_i} \times n_{1t_1} \right)}{n_{2t_1}} \right) - n_{o_i} \tag{2}$$

where

n_{d_i} = passage estimate for a given day (i) of the inoperable period,

n_{2d_i} = passage for the i^{th} day in the model data set 2,

n_{1t_1} = known cumulative passage for the operational time period (t_1) from the estimated data set 1,

n_{2t_1} = known cumulative passage for the corresponding time period (t_1) from the model data set 2, and

n_{o_i} = observed passage (if any) from the given day (i) being estimated.

Estimates Required in 2006

In 2006, the "linear method" was used to estimate missed Chinook, chum, coho, and sockeye salmon passage when the weir was not operational between 19 and 22 August. No other estimates were required.

Carcasses

Spawned out and/or dead salmon (hereafter referred to as carcasses) that accumulated on the weir were counted by species and sex before being passed downstream. The daily carcass count was tallied by species and sex and recorded into a designated logbook.

Age, Sex, and Length Composition

Age, sex, and length composition of the total annual Chinook, chum, and coho salmon escapements were estimated by sampling a fraction of fish passage and applying the sample ASL composition of those samples to the total escapement (DuBois and Molyneaux 2000).

Sample Collection

The crew at the Takotna River weir employed standard sampling techniques as described by DuBois and Molyneaux (2000). For chum and coho salmon, a pulse sampling design was used, in which moderate sampling was conducted for 3 days followed by a few days without sampling. The goal of each pulse was to sample 200 chum and 170 coho salmon. The pulse sample design was more loosely followed with Chinook salmon such that the goal to sample a minimum of 210 Chinook salmon from each third of the run preceded the goal to sample in pulses, resulting in a near daily Chinook salmon sample collection throughout most of the target operational period.

Sample sizes were selected so that the simultaneous 95% confidence interval estimates of age and sex composition proportions would be no wider than 0.20 (Bromaghin 1993) per pulse (or per third of the run in the case of Chinook salmon) for chum salmon assuming 8 age/sex categories, for coho salmon assuming 6 age/sex categories, and for Chinook salmon assuming 10 age/sex categories. Target sample sizes for all species were increased by about 10% from that recommended by Bromaghin (1993) to account for scales that could not be aged. The minimum acceptable number of sample periods for Chinook, chum, and coho salmon was 3 per species, 1 sample period representing each third of the run, to account for temporal dynamics in the ASL composition.

Salmon were sampled from a fish trap installed in the weir as described by Schwanke et al. (2001). The trap structure included an entrance gate, holding box, and exit gate. On days when sampling was conducted, the entrance gate was opened while the exit gate remained closed, allowing fish to accumulate inside the 5 by 8-ft (1.5 by 2.4-m) holding box. The holding box was allowed to fill with fish between counting shifts and sampling was conducted during the next scheduled counting period. Every fish of the target species was measured for length to the nearest millimeter from mideye to tail fork (METF) and identified as male or female through visual examination of the external morphology. Three scales were removed from the preferred area of the fish (INPFC 1963), placed on gum cards, and later used to determine age. Detailed sampling methods were similar to those described by Costello et al. (2005).

Additional samples were collected through active sampling. Active sampling required a technician to be positioned at the downstream end of the trap to observe fish entering the holding pen. When a salmon entered the holding pen, the technician would immediately close both the entrance and exit gates, thereby actively trapping the salmon inside the holding box for sampling. Active sampling was used mostly for Chinook salmon and for tag recoveries.

After sampling was completed, relevant information such as sex, length, date, and location was copied from hardcopy forms to computer mark-sense forms. Further details of sampling procedures can be found in DuBois and Molyneaux (2000) and Costello et al. (2005). The completed gum cards and data forms were sent to the Bethel and Anchorage ADF&G offices for processing, and archived at the ADF&G office in Anchorage. The computer files were archived by ADF&G staff in the Anchorage and Bethel offices, and data were loaded into the Arctic-Yukon-Kuskokwim (AYK) salmon database management system (Brannian et al. 2005).

Estimating Age, Sex, and Length Composition of Escapement

ADF&G staff in Bethel and Anchorage aged scales, processed the ASL data, and generated data summaries. DuBois and Molyneaux (2000) describe details of the processing and summarizing procedures. These procedures generated two types of summary tables for each species: 1 described the age and sex composition and the other described length statistics. These summaries account for changes in the ASL composition throughout the season by first partitioning the season into temporal strata based on pulse sample dates and/or sample size requirements, applying the ASL composition of individual temporal samples to the corresponding temporal strata, and finally summing the strata to generate the estimated ASL composition for the season. This procedure ensures that the ASL composition of the total annual escapement is weighted by the abundance of fish in the escapement rather than by the abundance of fish in the samples. For example, if samples of coho salmon were collected in 6 pulses, then the season would be partitioned into 6 temporal strata with 1 pulse sample occurring in each stratum. A sample of 140 coho salmon collected from 3 to 6 September would be used to estimate the ASL composition of the 400 coho salmon that passed the weir during the temporal strata that extended from 2 to 7 September. This procedure would be repeated for each stratum, and the estimated age and sex composition for the total annual escapement would be calculated as the sum of coho salmon in each stratum. In similar fashion, the estimated mean length composition for the total annual escapement would be calculated by weighting the mean lengths in each stratum by the escapement of coho salmon that passed the weir during that stratum. Confidence intervals were constructed for the estimated mean lengths according to Thompson (1992, page 105).

Throughout this document, fish ages are reported using European notation. European notation is composed of 2 numerals separated by a decimal where the first numeral indicates the number of winters the juvenile spent in fresh water and the second numeral indicates the number of winters spent in the ocean (Groot and Margolis 1991). Total age of a fish is equal to the sum of both numerals, plus 1 year to account for the winter when the egg was incubating in gravel. For example, a Chinook salmon described as an age-1.4 fish is actually 6 years of age. European notation will be used throughout this document to represent specific age classes, which indicate fish with a particular life history strategy. Total age will be used when discussing brood size because broods often consist of same age fish with different life history strategies. For example a brood of age-6 Chinook salmon may consist of age-1.4 and age-2.3 fish.

Visual Sex Determination

Sex was determined for every salmon passing upstream of the weir by focusing on sexually dimorphic characteristics, which may be a more comprehensive way of determining sex composition in tributaries with low turbidity. The sex compositions derived from the two methods were compared to assess possible bias in the ASL sampling method. In this comparison, each ASL stratum was considered independently, and the sex composition of escapement during a particular stratum as estimated from ASL sampling was compared to the sex composition of escapement determined through the sex identification of every salmon during the same time period.

WEATHER AND STREAM OBSERVATIONS

Water and air temperatures were measured at the Takotna River weir each day at approximately 0800 and 1700 hours. These times varied slightly with counting schedules. Temperatures were measured using a calibrated thermometer. Water temperature was determined by submerging the thermometer below the water surface until the temperature reading stabilized and air temperature was obtained from a thermometer placed in a shaded location near the weir site. Temperature readings were recorded in the logbook, along with notations about wind direction, estimated wind speed, cloud cover, and precipitation. Daily precipitation was measured using a rain gauge.

Daily operations included monitoring river depth with a standardized staff gauge. The staff gauge consisted of a metal rod driven into the stream channel with a meter stick attached. The height of the water surface, as measured from the meter stick, represented the “stage” of the river above an established datum plane. The staff gauge was calibrated to the datum plane by a semi-permanent benchmark located about 6 m from the river bank and consisted of a nail driven into a tree. The height of the nail corresponded to stage measurements of 300 mm relative to the datum plane. River stage was measured at approximately 0800 and 1700 hours.

JUVENILE SALMON INVESTIGATIONS

Study Area

Investigators have been interested in the distribution of juvenile salmon in the Takotna River drainage since 2000. To address this objective, the drainage was divided into 14 geographic zones, referred to as Index Areas (Figure 3). Efforts were made to investigate each area for the presence of juvenile salmon at least once per season, but the remoteness of many of the Index

Areas and low water conditions made that task nearly impossible in recent years. High water conditions in 2006 permitted travel to some of the more remote Index Areas that have been necessarily ignored in recent years. Specific sites were selected in each Index Area based on accessibility and distance from neighboring Index Areas, and each site was considered representative of the entire Index Area and allowed for consistent repeat sampling when opportunity allowed. Selected sites were considered sufficiently far from neighboring Index Areas that juvenile salmon caught at each site were assumed to be rearing in that location.

Sampling Efforts

Due to funding shortfalls in 2006, sampling was largely conducted by volunteer effort. Recognizing the reduction in funding, the Takotna River weir crew was not overtly tasked to investigate juvenile salmon distribution; instead, it remained at the crew leader's discretion if and when sampling would be conducted understanding that such sampling objectives were secondary to all other weir obligations. Any data collected would be considered supplementary.

All sampling in 2006 was conducted using minnow traps that had 1/4-in mesh (6.4 mm) and were baited with salmon roe hung in perforated bags inside the trap. Traps were set along both banks of the chosen site in about 100-ft (30-m) intervals to minimize bias associated with trap placement, and were allowed to soak for 10 to 24 hours. The number of traps set at each location and exact soak time were recorded and added to the database.

Distribution

Regardless of capture method, the number of each species captured was recorded along with a brief habitat description, and later archived in a database kept at the ADF&G office in Anchorage. Catch per unit effort (CPUE) was calculated for minnow trapping events as a means for describing juvenile salmon distribution in the drainage. CPUE was calculated following the guidelines set forth by Murphy and Willis (1996) using the following formula:

$$\hat{R}_2 = \frac{\sum_{i=1}^{n} c_i}{\sum_{i=1}^{n} e_i} \tag{3}$$

where

$\sum_{i=1}^{n} c_i$ = sum fish captured per trap (c_i) over all traps (n),

$\sum_{i=1}^{n} e_i$ = sum hours fished per trap (e_i) over all traps (n), and

$\hat{R}_2$ = catch per unit effort (CPUE).

This method of calculating CPUE is different from that used prior to 2004; thus, any discrepancies between CPUE values in this report and those of previous reports are attributed to the new methodology.

Length Patterns

All captured salmon were to be measured for fork length (FL) to the nearest millimeter using a straight edged ruler. Recorded lengths were to be archived in a database kept at the ADF&G office in Anchorage.

RELATED FISHERIES PROJECTS

Inriver Abundance of Chinook Salmon in the Kuskokwim River

The Takotna River weir was a component of a radiotelemetry project entitled *Invriver Abundance of Chinook Salmon in the Kuskokwim River* intended to estimate the total abundance of Chinook salmon in the Kuskokwim River (Stuby 2003, 2004, 2005, 2006, *In prep*). Radio transmitters were inserted into select Chinook salmon with lengths greater than 450 mm caught near upper Kalskag (rkm 270) following methods described by Stuby (*In prep*; Figure 1). The Takotna River had one of several radio receiver stations intended to monitor passage of radio-equipped fish into tributary streams. The Takotna River receiver station was placed approximately 300 m downstream from the weir. Though Chinook salmon were also fitted with a spaghetti tag that allowed the weir crew to recognize a radiotagged Chinook, no attempt was made to capture these fish since they were monitored by the receiver station and later noted by aerial surveys. The known Chinook salmon passage at the weir, coupled with data collected from the receiver station, were used with similar data collected at other weir projects to develop estimates of the total Chinook salmon abundance upstream from the Lower Kalskag tagging site. Complete methodology is provided by Stuby (*In prep*). Results of this study will be a critical component of a related project entitled *Kuskokwim River Chinook Salmon Run Reconstruction*, which entails a two-part approach to develop a statistical model that will use fragments of historical information to estimate a time series of annual Chinook salmon abundance in the Kuskokwim River from the 1970s through 2007.

The Takotna River weir and crew facilitated this project by monitoring a receiver station located near the weir, providing a means to recapture radiotagged Chinook salmon passing upstream of the weir, and enumerating total passage of Chinook salmon upstream of the weir. The receiver was downloaded periodically by the weir crew and data were sent to researchers as often as possible throughout the season. For each recaptured fish, the crew recorded the date of capture, tag number, tag color, and the general condition of the fish.

Kuskokwim River Sockeye Salmon Investigations

The Takotna River weir was used as a platform for the project entitled *Kuskokwim River Sockeye Salmon Investigations*. This project was designed to address critical knowledge gaps in the biology and ecology of Kuskokwim River sockeye salmon. Specifically, this project aimed to describe the location and relative abundance of sockeye salmon spawning aggregates, estimate stock-specific run-timing in the main stem of the Kuskokwim River, describe and compare habitat use and seasonal migration patterns of river-type and lake-type juveniles, and describe and compare smolt size and growth among tributaries and habitat types. These goals were addressed by conducting a two-sample mark–recapture study within the upper Kuskokwim River drainage above Kalskag and conducting juvenile studies within various habitat types throughout the Holitna drainage.

Similar to the Chinook project, radio transmitters were inserted into Sockeye salmon caught near Kalskag. Radiotagged fish were also equipped with a spaghetti tag to assess incidences of tag loss. A combination of radio receiver stations located throughout the upper Kuskokwim River drainage (the same receiver stations used for the Chinook project) and aerial surveys was used to monitor the movement of tagged fish. Juvenile salmon were sampled from various habitat types throughout the Holitna drainage using standard seining techniques. The known sockeye salmon passage at the weir projects located throughout the upper drainage, coupled with data collected from tracking efforts, was used to address distribution, abundance, and run-timing of spawning aggregates. Data from seining efforts were used to address habitat use, out migration timing, and variation in size and growth of juvenile sockeye salmon.

The Takotna River weir and crew facilitated this project by monitoring a receiver station located near the weir, providing a means to recapture radiotagged sockeye salmon passing upstream of the weir, and enumerating total passage of sockeye salmon upstream of the weir. The services performed on the tracking station for the Chinook salmon radiotelemetry project also benefited the radiotelemetry component of *Kuskokwim River Sockeye Salmon Investigations*.

Kuskokwim River Salmon Mark–Recapture Project

The Takotna River weir was used as a platform for the project entitled *Kuskokwim River Salmon Mark–Recapture Project*. In 2006 this project was designed to investigate stock-specific run-timing and travel speed of Kuskokwim River Chinook and sockeye salmon (Baumer et al. *In prep*). These goals were addressed by conducting a two-sample mark–recapture study within the upper Kuskokwim River drainage above Kalskag. Uniquely numbered anchor tags were attached to Chinook and sockeye salmon caught using fish wheels and drift gillnets near Kalskag. Weir crews at projects located throughout the upper Kuskokwim River drainage recaptured observed tagged fish in the same live trap used for ASL sampling. Known recapture dates and tag number from the weirs coupled with known deployment dates of recaptured tags from the Kalskag tagging site was used to develop estimates of stock-specific run timing and travel speed. For the purpose of estimating stock-specific run-timing for each species, fish radio-tagged as part of concurrent research efforts were pooled with anchor-tagged fish to increase sample size. This was considered appropriate since similar gear types were used for capture, and the objectives of both projects were considered in the tag deployment schedule. The pooling of both samples likely resulted in a better estimate of stock-specific run-timing than either considered independently because the radio-tag to anchor-tag ratio varied from day to day when radio-tags were deployed according to a rigid predetermined schedule and anchor tags were affixed to the remaining catch. Complete methodology is presented by Baumer et al. (*In prep*).

The Takotna River weir and crew facilitated this effort by recapturing observed anchor tagged Chinook and sockeye salmon. For each recaptured fish, the crew recorded date of recapture, tag number, tag color, and the general condition of the fish. In addition, crews randomly examined Chinook and sockeye salmon through ASL sampling for the presence of a severed adipose fin that served as a secondary mark to assess tag loss. Baumer et al. (*In prep*) provides details.

RESULTS

ESCAPEMENT MONITORING

Installation of the Takotna River weir began on 9 June and was complete at 1500 hours on 16 June, 8 days before the target operational date of 24 June. Disassembly began on 23 September, and the weir was completely removed 2 days later. The weir remained operational for all but 4 days of the target operational period (19–22 August) when it was rendered inoperative due to high water levels.

Chinook Salmon

A total of 540 Chinook salmon passed the weir between 16 June and 22 September, which includes estimated passage (2 fish) for the 4-day inoperative period from 19 to 22 August (Table 1; Appendix A1). Estimates for the inoperative period were derived from the "linear method" for interpolating missed passage. Of the total escapement, 539 passed during the target operational period that began on 24 June and ended on 20 September. The central 50% of passage occurred between 9 and 21 July, and the last Chinook salmon was reported on 31 August (Table 1; Figure 4). Peak daily passage of 61 fish occurred on 20 July, and the median passage date was 18 July (Table 1; Figure 4).

Chum Salmon

A total of 12,613 chum salmon passed the weir between 16 June and 22 September, which includes estimated passage (32 fish) for the 4-day inoperative period from 19 to 22 August (Table 1; Appendix A2). As with Chinook, estimates for the inoperative period were derived from the "linear method" for interpolating missed passage. Of the total escapement, 12,598 passed during the target operational period that began on 24 June and ended on 20 September. The central 50% of passage occurred between 8 and 22 July, and the last chum salmon was reported on 16 September (Table 1; Figure 4). Peak daily passage of 616 fish occurred on 7 July, and the median passage date was 14 July (Table 1; Figure 4).

Coho Salmon

A total of 5,647 coho salmon passed the weir between 16 June and 22 September, which includes estimated passage (665 fish) for the 4-day inoperative period from 19 to 22 August (Table 1; Appendix A3). As with other species, estimates for the inoperative period were derived from the "linear method" for interpolating missed passage. Coho salmon were observed passing from 30 July to 22 September when weir removal began. Of the total escapement, 5,548 passed during the target operational period that began on 24 June and ended on 20 September. Considering only escapement during the target operational period, the central 50% of passage occurred between 22 August and 6 September (Table 1; Figure 4). Peak daily passage of 328 fish occurred on 8 September, and the median passage date was 28 August (Table 1; Figure 4).

Other Species

Sockeye Salmon

Sockeye salmon are uncommon in the Takotna River. A total of 60 sockeye salmon passed upstream of the weir during the target operational period, which includes estimated passage (6 fish) for the 4-day inoperative period from 19 to 22 August (Appendix B1). Sockeye salmon were observed passing upstream of the weir between 27 July and 19 September and daily passage peaked at 6 fish on 14 August. Based on total estimated escapement during the target operational period, the median passage date was 15 August and the central 50% of the run occurred between 11 and 21 August.

Pink Salmon

Pink salmon *O. gorbuscha* are extremely rare in the Takotna River. One pink salmon was observed in 2006, on 7 July (Appendix B1).

Resident Species

Three resident fish species were observed passing upstream of the weir in 2006. Longnose suckers were the most abundant, with 1,161 fish passing the weir between 16 June and 20 September, and 518 passing during the target operational period (Appendix B1). Other species that passed upstream included 41 northern pike and 35 whitefish *Coregonus spp*. Passage of resident species was not estimated for days when the weir was not operational.

Carcasses

A total of 402 salmon carcasses were recovered from the Takotna River weir (Appendix C1), representing about 2% of the observed escapement of all Pacific salmon species. A total of 25 Chinook salmon carcasses were recovered (4.7 of the observed annual escapement) between 24 July and 26 August. A total of 360 chum salmon carcasses were recovered (2.9% of the observed annual escapement) between 29 June and 21 September. A total of 15 coho salmon carcasses were recovered (0.3% of the observed annual escapement) between 26 August and 22 September, the last day of weir operations. A total of 2 sockeye salmon carcasses were recovered (3.7% of the observed annual escapement): 1 on 26 August and the other on 22 September. Females accounted for 4% of the Chinook, 29% of the chum, and 40% of the coho salmon carcasses recovered from the weir. Other species recovered included 7 whitefish and 3 northern pike.

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

Chinook salmon ASL sampling at the Kogrukluk River weir consisted of modest daily effort from 29 June to 14 July and from 17 July to 8 August. This effort resulted in a total sample of 309 fish. Of those, age was determined for 269 Chinook salmon (87% of the total sample), or 49.9% of the total Chinook escapement in 2006 (Tables 2 and 3). The total annual escapement was partitioned into 3 temporal strata based on the temporal distribution of the sampling effort and sample size requirements, with sample sizes of 106, 80, and 83 aged fish per stratum, respectively (Table 2). Sampling size objectives were not achieved for Chinook salmon, but postseason analysis revealed that sample sizes were adequate for estimating total and intra-annual age, sex, and length composition of Chinook salmon escapement to the Takotna River weir in 2006.

Each Chinook salmon age *group* was comprised of only one age *class*. All age-3, -4, -5, -6, and -7 fish were of the -1.1, -1.2, -1.3, -1.4, and -1.5 age classes, respectively; no age-2.1, -2.2, -2.3, or -2.4 fish were found in 2006 (Table 2), though they are occasionally found in some tributaries. The 2006 Chinook salmon escapement was dominated by three age classes, which combined comprised over 95% of the total annual escapement (Table 2; Figure 5). Age-1.2 was the most abundant age class comprised (42%), followed by age-1.3 (30%), and age-1.4 (23%). Representing 1.7% and 2.6%, respectively, age-1.1 and age-1.5 fish comprised only a tiny fraction of escapement in 2006, and no age-8 fish were observed in the sample. Intra-annual variation in the proportion of age-1.2, -1.3, and -1.4 Chinook salmon was observed, but none followed a uniform increasing or decreasing trend (Table 2; Figure 6). As the run progressed, the proportion of age-1.3 fish remained fairly constant (between 26.3% and 33.7%). The proportion of age-1.4 fish was highest towards the end of the run (37.3% in the last stratum), but the proportion of age-1.2 fish was highest towards the middle of the run (58.8% in the middle stratum). Age-1.4 was the dominant age class towards the end of the run; otherwise, age-1.2 was consistently dominant.

Based on ASL sampling, the ratio of males to females in the Chinook salmon escapement past the Takotna River weir was approximately 3:1 (Table 2). Female Chinook salmon comprised 23.3% of the total annual escapement based on weighted ASL samples. Sex composition varied during the run (Figure 7). Females represented only a modest fraction of the total escapement in the first 2 sampling strata (17.0% and 15.0%, respectively), but their proportion increased to 39.8% in the last stratum with the arrival of more age-1.4 fish. The female escapement was dominated (69.6%) by older age-1.4 individuals. Conversely, the male escapement was largely comprised of younger age-1.2 and -1.3 individuals, representing 55.1% and 32.9% of the total male escapement, respectively.

The method of identifying the sex of every passing salmon yielded a sex ratio similar to that derived from ASL sampling (Figure 8). Based on this method, female Chinook salmon comprised 20.5% of the total annual escapement. Stratification of male and female passage counts into the same temporal strata used in the process of estimating intra-annual trends in ASL composition revealed that percent females tended to increase over the course of the Chinook salmon run in 2006 (Figure 8). Determined through regular passage counts, females comprised 14.1%, 17.5%, and 69.2% of total Chinook salmon escapement during the first, second, and third stratum, respectively.

Analysis of length composition suggested partitioning by sex and age class. The length of female Chinook salmon ranged from 607 to 1012 mm, and males ranged from 362 to 924 mm (Table 3). Female Chinook salmon were consistently larger at age than males, and generally average length increased with age for both females and males. Average lengths for female age-1.3, -1.4, and -1.5 Chinook salmon were 767, 853, and 847 mm, respectively. Average lengths for male age-1.1, -1.2, -1.3, and -1.4 Chinook salmon were 389, 561, 687, and 775 mm, respectively. One male age-1.5 Chinook salmon was sampled with a length of 813 mm. Annual length at age showed little intra-annual variation for both male and female Chinook salmon (Table 3; Figure 9).

Chum Salmon

Sampling goals for chum salmon were achieved in 2006. Samples were collected in 6 pulses with sample sizes of 210 fish during the first 5 pulses and 213 fish during the last pulse, for a total of 1,263 fish. Of those, age was determined for 1,169 chum salmon (93% of the total sample), or 9.3% of the total annual chum salmon escapement in 2006 (Tables 4 and 5). The chum run was partitioned into 6 temporal strata based the temporal distribution of the sampling effort, with sample sizes of ranging between 186 and 199 aged fish per stratum, respectively (Table 4). Sample sizes were adequate for estimating total and intra-annual age, sex, and length composition of chum salmon escapement to the Takotna River weir in 2006.

The chum salmon escapement past the weir was largely represented by two age classes, which combined comprised nearly 98% of the total chum salmon escapement at the Takotna River weir. Comprising 62.2% of total annual escapement, age-4 fish were the most abundant, followed by age-5 (35.5%; Table 4; Figure 5). Since virtually all chum salmon out-migrate the first spring or summer after emergence, all age-4 fish were of the -0.3 age class, and all age-5 fish were of the -0.4 age class (Table 4). All age/sex categories were represented in the 2006 chum salmon escapement; however, the contribution of the 3 year-olds (age-0.2) and 6 year-olds (age-0.5) was only 2% combined. Age composition changed considerably over the course of the run, especially in the proportion of the age-0.3 and -0.4 age classes. The proportion of age-0.3 chum salmon continually increased from 30.9% early in the run to 71.3% near the end (Table 4; Figure 10). Conversely, the proportion of age-0.4 chum salmon continually decreased from 68.0% early in the run to 21.5% near the end.

Based on ASL sampling, the proportion of males and females in the chum salmon escapement past the Takotna River weir was about equal (Table 4). Female chum salmon comprised 46.9% of the total annual escapement based on weighted ASL samples. Sex composition varied during the run (Figure 7). The proportional contribution of females increased sequentially with temporal strata, comprising 34.0%, 39.2%, 44.1%, 54.8%, 62.1%, and 66.2% during each successive stratum. The female escapement was dominated (67.8%) by age-0.3 individuals, while the male escapement was more evenly composed of age-0.3 and age-0.4 individuals, representing 57.2% and 41.5% of the total male escapement, respectively.

The method of identifying the sex of every passing salmon yielded a sex ratio similar to that derived from ASL sampling (Figure 8). Based on this method, female chum salmon comprised 51.3% of the total annual escapement. Stratification of male and female passage counts into the same temporal strata used in the process of estimating intra-annual trends in ASL composition revealed that percent females tended to increase over the course of the chum salmon run in 2006 (Figure 8). The proportional contribution of females in strata 1–6 was 40.0%, 46.8%, 50.7%, 57.1%, 59.9%, and 60.4%.

Analysis of length composition suggested partitioning by sex and age class. The length of female chum salmon ranged from 448 to 648 mm, and males ranged from 435 to 648 mm (Table 5). Male chum salmon were generally larger at age than females, and average length increased with age for both males and females. Average lengths for female age-0.2, -0.3, and -0.4 fish were 509, 540, and 552 mm, respectively. Average lengths for male age-0.2, -0.3, and -0.4 fish were 525, 560, and 577 mm, respectively. For both males and females, average length at age tended to decrease slightly over the course of the run (Table 5; Figure 11).

Coho Salmon

Sampling goals for coho salmon were achieved in 2006. Samples were collected in 3 pulses each with sample size of 170 fish, for a total of 510 fish. Of those, age was determined for 435 coho salmon (85% of the total sample), or 7.8% of the total annual coho salmon escapement in 2006 (Tables 6 and 7). The coho salmon run was partitioned into 3 temporal strata based on the temporal distribution of sampling effort, with sample sizes ranging between 138 and 154 aged fish per stratum (Table 6). Post-season analysis revealed that sample sizes were adequate for estimating total and intra-annual age, sex, and length composition of coho salmon escapement past the Takotna River weir in 2006.

The coho salmon escapement past the weir was dominated by age-4 fish, which comprised 93.2% of the total coho salmon escapement at the Takotna River weir. Age-3 and age-5 fish each comprised 3.4% of the escapement (Table 6; Figure 5). Since virtually all coho salmon spend only 1 winter at sea before returning to spawn, all 3, 4, and 5 year-old fish were of the

-1.1, -2.1, and -3.1 age classes, respectively (Table 6). No individuals from other age classes were sampled. Little intra-annual variation in age composition was observed, though the proportion of age-2.1 coho salmon increased slightly (Table 6). The proportion of age-1.1 and -3.1 coho salmon remained consistently low and varied little over the course of the run.

Based on ASL sampling, the proportion of males and females in the coho salmon escapement past the Takotna River weir was about equal (Table 6). Female coho salmon comprised 45.0% of the total annual escapement based on weighted ASL samples. Sex composition varied during the run (Table 7). The proportional contribution of females increased steadily over the course of the run, comprising 33.1%, 47.1%, and 49.0% of escapement during the first, second, and third strata, respectively. Both the male and female escapement was dominated by age-2.1 individuals, representing 92.8% and 93.7% of the total male and female escapement, respectively.

The method of identifying the sex of every passing salmon yielded a sex ratio similar to that derived from ASL sampling (Figure 8). Based on this method, female coho salmon comprised 46.7% of the total annual escapement. Stratification of male and female passage counts into the same temporal strata used in the process of estimating intra-annual trends in ASL composition revealed that percent females tended to increase over the course of the coho salmon run in 2006 (Figure 8). Percent female in the coho salmon escapement was 35.0% in the first stratum, 45.0% in the second, and 51.9% in the third.

Analysis of length composition suggested partitioning by sex and age class. The length of female coho salmon ranged from 365 to 659 mm, and males ranged from 388 to 601 (Table 7). Average lengths at age were remarkably similar between males and females, and little variation in average length was observed in any pair-wise comparisons. Average length varied little across all age/sex categories or during the course of the run (Table 7; Figure 12). Female coho salmon averaged 531 mm at age-1.1, 518 mm at age-2.1, and 522 mm at age-3.1. Similarly, male coho salmon averaged 526 mm at age-1.1, 518 mm at age-2.1, and 523 mm at age-3.1.

WEATHER AND STREAM OBSERVATIONS

In 2006, water levels at the Takotna River weir ranged from 54.0 to 153.0 cm, with an average of 70.9 cm for the overall operational period (Appendix D1). Throughout June and most of July water levels fluctuated between 59 and 85 cm but then dropped steadily until 11 August (Figure 13). Water levels rose rapidly after 11 August before reaching a seasonal maximum on 19 August. After 19 August, water levels dropped rapidly until the last observation was made 22 September. There was not an obvious correlation between water level and salmon passage through the weir (Figure 14).

Water temperatures in the Takotna River ranged from 5.8 to 18.5°C and averaged 10.7°C for the overall operational period (Appendix D1). Daily water temperature fluctuated dramatically from the first observation on 16 June until 17 August, but generally water temperature tended to decrease after reaching a seasonal maximum on 5 July (Figure 13). Water temperature decreased rapidly after 17 August before reaching a seasonal low on 21 August. From 21 August to the last observation on 22 September, water temperature slowly increased as water levels receded. Daily water temperature tended to vary inversely to water level. There was not an obvious correlation between water temperature and salmon passage through the weir (Figure 15).

Air temperature at the weir ranged from 0.3 to 32.4°C, with an average air temperature of 13.6°C for the operational period (Appendix D1). Air temperature is not thought to directly affect fish behavior around the Takotna River weir, so it will not be discussed in detail in this report.

JUVENILE SALMON INVESTIGATIONS

Sampling Efforts

This was the seventh consecutive year of juvenile salmon investigations in the Takotna River basin. Intensive sampling was conducted twice and in four Index Areas in 2006 (Tables 8 and 9). Sampling was conducted once in early June before weir operations began, and once in mid September concurrent with a personal excursion (Appendix E1). June sampling was conducted in Little Waldren Fork (Index Area 10) and Moore Creek (Index Area 11), which are the two most remote Index Areas and rarely surveyed (Tables 8 and 9). September sampling was conducted in Minnie Creek (Index Area 7) and in the main stem between Fourth of July Creek and Big Waldren Fork (Index Area 5), which are locations near the crew leader's seasonal camp.

Unfortunately, no juvenile salmon were captured in 2006 (Appendix E1). However, several resident species were captured incidentally, including slimy sculpin *Cottus cognatus,* burbot *Lota lota*, and blackfish *Dallia pectoralis*, a species that had not been caught during juvenile sampling before in the Takotna River.

Distribution

No juvenile salmon were captured despite considerable sampling efforts in June and September. On 2–3 June, a total of 50 traps were set in Moore Creek (Index Area 11) and allowed to soak for 15–20 hours, resulting in a total of 900 trap-hours (Tables 8 and 9). Shortly after, on 4 June, a total of 22 traps were set in Little Waldren Fork (Index Area 10) and allowed to soak for 10 hours, resulting in a total of 220 trap-hours (Tables 8 and 9). On 16 September, 21 traps were set in the main stem between Fourth of July Creek and Big Waldren Fork (Index Area 5), and 10 were set in Minnie Creek (Index Area 7). Traps set on 16 September were allowed to soak for 24 hours, resulting in a total of 744 trap-hours in Index Area 5 and 240 in Index Area 7 (Tables 8 and 9).

RELATED FISHERIES PROJECTS

Inriver Abundance of Chinook Salmon in the Kuskokwim River

No radiotagged Chinook salmon were detected by the receiver station located about 300 m downstream from the weir in 2006, and none were observed passing upstream of the weir. Though radiotagged Chinook were not detected by the Takotna River receiver station in 2006, the study did provide a statistically valid inriver abundance estimate using marked to unmarked ratios witnessed at other weirs. Complete results of this project will be reported in Stuby (*In prep*).

In 2006 this study provided an inriver abundance estimate of 233,233 Chinook salmon that were greater than 450 mm in length (SE = 28,450) for the Kuskokwim River drainage upstream of Kalskag, and an estimate of 165,538 (SE = 22,538) for the drainage upstream of the Aniak River confluence. Based on this estimate, the Takotna River stock represented 0.2% of total abundance upstream of Kalskag, and 0.3% of the abundance upstream of the Aniak River confluence. Detailed results for the Chinook salmon radiotelemetry study are reported in Stuby (*In prep*).

Kuskokwim River Sockeye Salmon Investigations

No radiotagged sockeye salmon were detected or observed passing the Takotna River weir or receiver station in 2006. Tagged sockeye were tracked to tributaries throughout the Kuskokwim River basin using 17 ground-based tracking stations, and 3 aerial tracking surveys conducted in July, August, and September. Of 498 tags deployed, 448 (90%) successfully resumed upstream migration, and 383 (77%) were successfully tracked to tributary streams. Radiotagged sockeye salmon were identified in all major drainages between Kalskag and the Swift river drainage. Large aggregates were observed in the Aniak, Holokuk, Holitna, Hoholitna, and Stony river drainages. The highest concentrations were observed throughout the Holitna River. Complete results of this project can be obtained from Gilk (Sara E. Gilk, Commercial Fisheries Biologist, ADF&G, Anchorage; personal communication).

Kuskokwim River Salmon Mark–Recapture Project

Tag recovery efforts at the Takotna River weir were successful in 2006. The weir remained operational for nearly the entire Chinook and sockeye salmon runs, so no tagged fish of these species were likely to have passed the weir without detection. The effect of the brief inoperable period on Chinook and sockeye salmon tag recovery (i.e. recording of the unique tag number) was probably minimal if passage estimates for this period are accurate. Only 2 Chinook and 4 sockeye salmon were estimated to have passed during the inoperative period, representing only about 0.4% and 6.6% of annual escapement, respectively (Baumer et al. *In prep*). In addition, all passage was successfully conducted through the live trap, due to above-average seasonal water levels, which allowed crew members to at least observe every tagged fish passing upstream of the weir.

Despite the presumed success of tag recovery at the Takotna River weir in 2006, only 1 sockeye and no Chinook salmon were observed with anchor tags (Baumer et al. *In prep*). The observed tagged sockeye salmon was successfully captured and its tag number recovered. No secondary tag marks that would have indicated tag loss were found among 309 Chinook salmon examined through the process of ASL sampling, and 37 sockeye salmon handled to confirm their untagged status.

Recovery of the sockeye salmon tag number on 26 August offered an opportunity to study migration characteristics of that fish. The recorded tag number revealed that the tagged sockeye salmon was captured and tagged on 3 August, 23 days before being recaptured at the weir. The resulting travel speed for this fish was approximately 29 km/day (Baumer et al. *In prep*).

DISCUSSION

ESCAPEMENT MONITORING

The reported Chinook, chum, and sockeye escapements in 2006 are considered accurate representations of annual escapements to the Takotna River. Daily passage trends indicated few, if any, Chinook, chum, and sockeye salmon passed the weir site before or after the target operational period (Table 1). Unfortunately, actual annual coho salmon escapement was likely slightly higher than reported because passage was still considerable even 2 days after the last day of the target operational period (Table 1; Appendix A3) and showed no signs of slowing during the 10-day period immediately before. Thus, it is likely that a considerable number of coho salmon passed the weir site after counting ceased on 23 September. However, reported escapement during the target operational period is considered accurate for all species because the weir suffered only one brief inoperable period (between 19 and 22 August) and the method used to generate estimates for missed salmon passage during this period is commonly used in the Kuskokwim River drainage. The estimates generated using this method represented only a modest fraction of total escapement by species (Table 1).

Chinook Salmon

Abundance

The 539 Chinook salmon reported to have passed upstream of the Takotna River weir during the target operational period of 24 June through 20 September is considered a reliable estimate of total annual escapement upstream of the weir in 2006 (Table 1). Only 1 Chinook salmon was observed passing the weir before the target operational date, and no Chinook salmon were observed after 31 August. The 2 fish estimated to have passed the weir during the brief inoperable period in August constituted only a small fraction (0.4%) of the total escapement in 2006 (Table 1).

Chinook salmon escapement has been determined in all years the weir has operated as well as in 1996 and 1997 when counting towers were used (Molyneaux et al. 2000). Escapement in 2006 was higher than most past years, falling short of only 2001 and 1997 (Figure 16). Escapement in 2001, enumerated using the same weir installed in 2000 and subsequent years, was only moderately higher than in 2006; the largest disparity is between 2006 and 1997. However, the accuracy of the record escapement reported during these years is generally not considered high because the escapement monitoring program on the Takotna River was still in its infancy and escapement was initially enumerated using a counting tower, which project leaders suspect is a less accurate method when implemented in the Takotna River (Appendix A1).

Escapement goals have not yet been established for Takotna River Chinook salmon due to a recognized lack of historical escapement data, which precludes assessment of the adequacy of the 2006 escapement. At the time of this report, the time series of historical data for the Takotna River weir was not sufficient to apply the Bue and Hasbrouck (2001) method for developing a sustainable escapement goal (SEG) range, for which a minimum of 10 years of escapement data (one life cycle of returns) are generally required (Molyneaux and Brannian 2006). If successful weir operation continues, the 10-year minimum requirement for establishing an SEG will be achieved in 2009, and an SEG will likely be proposed to the Alaska Board of Fisheries in 2010. If investigators choose to also use escapement data collected through the use of counting towers, the minimum data series required for Bue and Hasbrouck application could be as early as 2007 (after 2007 escapement is determined). Using weir- and tower-determined escapement data collected through 2005, the SEG derived from the Bue and Hasbrouck method would range between 347 and 710, in which most years of escapement would fall near or below the median. This SEG range is considerably below the estimates for the number of spawners at maximum sustained yield (S_{msy}) and spawners at carrying capacity (S_c), 3,731 and 9,935 fish, derived using the habitat-based model developed by Parken et al. (2004) and described by Molyneaux and Brannian (2006). This suggested carrying capacity is slightly above that suggested for the Tatlawiksuk River using the same method and existing data, though the Chinook salmon escapement at the Takotna River weir is generally much less. For both systems, carrying capacity based on the habitat-based models implies the potential for much higher escapements than currently observed.

The overall Kuskokwim River Chinook salmon escapement was considered above average in 2006 and escapement goals were met or exceeded in tributaries where they have been established (Figure 16; ADF&G 2004). Generally, escapements have improved in recent years from below-average levels in 1998–2000 (Figure 16; Bergstrom and Whitmore 2004; Molyneaux and Brannian 2006). The Kuskokwim River Chinook salmon escapement index was only slightly lower than in 2004 and 2005, which are the highest years on record (Figure 16). The strength of the Chinook salmon run relative to past years was highly variable in 2006. Unlike all other weirs in the Kuskokwim River drainage and the calculated drainage-wide escapement index, Chinook salmon escapement to the Takotna River weir has been increasing steadily, but gradually, over the last 6 years (Figure 16; Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Most projects reported a decrease between 2005 and 2006, down to nearly average at some locations. Regardless of how they differ between this year and last, Chinook salmon escapement at all projects tended to increase between 2000 and 2005, as did the composite index, and escapements in 2006 were considerably higher than in 1999 and 2000, which were the years that prompted the BOF "stock of concern" designation in 2001 (Figure 16; Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

Abundance estimates provided by the radio tagging of Chinook salmon in the Kuskokwim River have, in general, followed similar trends seen in the other measures of abundance (weir escapement, aerial survey information, and composite index). The estimate of 165,538 Chinook salmon that escaped upstream of the Aniak River confluence in 2006 is the highest on record, but similar to 2005 (Stuby *In prep*). Prior to 2006, estimates have ranged from 100,733 in 2002 to 145,373 in 2005 (Stuby 2006). This increase in abundance for the entire upper drainage is mirrored in the observed annual escapements at each of the upriver weir projects (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). This relationship suggests that the combined escapement estimates from the George, Tatlawiksuk, Kogrukluk, and Takotna river weirs provide a suitable index of inriver abundance of Chinook salmon upstream of the Aniak River. Takotna River Chinook salmon consistently comprise approximately 0.3% of the total annual estimate upstream of the Aniak River confluence. This proportional contribution is considerably lower than what is consistently reported for other weirs (about 12%).

Since the late 1980s, Chinook salmon have received little harvest pressure from the commercial fishery. Chinook salmon have not been targeted for commercial exploitation since 1987 and annual harvests since that time have been incidental to other species (Linderman and Bergstrom 2006). When compared to the total of 233,233 Chinook salmon estimated to have migrated past Kalskag in 2006, the harvest of 2,777 Chinook salmon probably had negligible impact on Kuskokwim River Chinook salmon stocks. The 165,538 Chinook salmon estimated to have migrated upstream of the Aniak River confluence in 2006 based on mark–recapture and radiotelemetry was the highest among the recent 5 years with comparable data even though the reported commercial harvest was considerably less than the recent 10-year average of 4,313 fish and the pre-2001 10-year average of 18,081 fish (Linderman and Bergstrom 2006). The relatively small harvest in 2006 is likely the combined effect of conservative management and low permit utilization (Linderman and Bergstrom 2006). A lack of commercial markets for chum salmon in recent years has depressed ex-vessel prices and reduced the number of permit holders actively fishing.

The number of Chinook salmon harvested in the subsistence fishery is much greater than the commercial harvest. Estimates are not yet available for the 2006 (or 2005) subsistence harvests, but the 1995–2004 average harvest was 76,980 (Martz and Dull 2006). Harvests have remained relatively stable since the late 1980s, making it likely that the subsistence harvests in 2005 and 2006 were probably near this average. When compared to the number of Chinook salmon estimated to have migrated past Kalskag, the number of Chinook salmon harvested for subsistence use is significant and represents a much larger fraction of total run abundance than the commercial harvest. Recognizing the implications of the BOF stock of concern designation, ADF&G implemented a subsistence fishing schedule in 2001 that was intended to distribute subsistence fishing effort more evenly throughout the Kuskokwim River Chinook salmon run (Molyneaux and Brannian 2006). The subsistence fishing schedule was implemented to mitigate a concern that subsistence fishers in the lower Kuskokwim River were harvesting an unreasonable share of early-running stocks, thereby decreasing the opportunity for fishers further upriver to meet their subsistence needs. Though it was not the focus of the subsistence fishing schedule, ADF&G biologists thought that the diffusion of harvest effort would probably benefit early-migrating salmon stocks. While it was being practiced, the subsistence fishing schedule was being studied for its effectiveness. After several years of implementation, there is now evidence that the fishing schedule was not producing the desired result and has little effect on the timing of subsistence harvest efforts (Toshihide Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication). The subsistence fishing schedule has probably provided no benefit to upper river stocks such as that bound for the Takotna River.

Spawning Locations

Due to budget shortfalls, aerial surveys were not flown in the Takotna River drainage in 2006. However, surveys flown in past years reveal that most Chinook salmon spawning occurs in Fourth of July Creek (Figure 3; Clark and Molyneaux 2003; Costello et al. 2005; Costello et al. 2006; Gilk and Molyneaux 2004; Schwanke et al. 2001; Schwanke and Molyneaux 2002).

Run Timing at Weir

Based on median passage dates, the timing of the Chinook salmon run at Takotna River weir in 2006 (18 July) was among the latest on record (Figure 4; Appendix F1). Being equal to 2000 and 2003, the median passage date in 2006 was 5 to 13 days later than other years. With central 50% passage occurring over a 15-day period and central 80% occurring over a 27-day period, the Chinook salmon run in 2006 was similar in duration to previous years. Later-than-average run timing was observed at most other ground-based escapement monitoring projects in the Kuskokwim River in 2006 (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

Index Value

One of the arguments supporting operation of the Takotna River weir is that it provides a measure of escapement that can be applied as an index for the upper Kuskokwim River drainage. The only other escapement monitoring regularly conducted in the upper Kuskokwim River is aerial surveys of the Salmon River (Pitka Fork drainage), a formal escapement index stream (Burkey et al. 2002). The Salmon River surveys, however, focus only on Chinook salmon and are not conducted every year. To date, there are 7 years of paired Chinook escapement measures for both the Takotna and the Salmon River, but they do not correlate (R^2 = 0.0058; Figure 17). To what extent this is due to differences in stock abundance or to error associated with counting fish from an airplane is uncertain, especially since aerial surveys are notoriously unreliable measures of escapement. Survey date, time of day, weather, pilot, and, perhaps more importantly, experience and capability of the observer are all variables that can affect the outcome of a survey. Therefore, the aerial survey conducted annually on the Salmon River is probably not an adequate index for the entire upper Kuskokwim River drainage upstream of the Tatlawiksuk River.

Chum Salmon

Abundance

The 12,598 chum salmon reported to have passed upstream of the Takotna River weir during the target operational period of 24 June through 20 September is considered a reliable estimate of total annual escapement upstream of the weir in 2006 (Table 1). Only 16 chum salmon were observed passing the weir before the target operational date, and no chum salmon were observed after 16 September. The 32 fish estimated to have passed the weir during the brief inoperable period in August constituted only a small fraction (0.3%) of the total escapement in 2006 (Table 1).

Chum salmon escapement has been determined in all years the weir has operated as well as in 1996 and 1997 when counting towers were used (Molyneaux et al. 2000). Escapement in 2006 was the highest on record and nearly twice the escapement reported in 2005, which was the highest to date. The 2006 chum salmon escapement was over 10 times the escapement in 2000, which was one of the years that contributed to the “stock of concern” designation by the BOF (Figure 18; Appendix A2; Burkey et al. 2000b). No formal escapement goals have been established for Takotna River chum salmon, which precludes assessment of the adequacy of the escapement. However, in tributaries where escapement goals have been established (Aniak River sonar and Kogrukluk River weir; ADF&G 2004), escapement goals were exceeded in 2006 and escapements were well above those reported in 1998–2000 at other projects (Figure 18; Bergstrom and Whitmore 2004).

The dramatic increase in chum salmon escapement at the Takotna River weir in 2006 was not observed at most other escapement monitoring projects in the Kuskokwim River, though all projects reported escapements well above average (Figure 18; Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; McEwen *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Most projects reported a decrease of varying degrees in chum salmon escapement between 2005 and 2006. Only the George River weir reported a dramatic increase in chum salmon escapement similar to the Takotna River weir (Figure 18; Hildebrand et al. 2007). At most other monitored locations in the drainage, chum salmon escapements have recovered from below-average levels in 1999 and 2000 to intermediate levels in recent years, and to record high levels in 2005 and 2006 based on historical escapement estimates (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; McEwen *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). However, unlike other weir projects in the Kuskokwim River, escapement at the Takotna River weir declined steadily between 2001 and 2004 before rebounding in 2005 (Figure 18; Appendix A2).

Escapement goals have not yet been established for Takotna River chum salmon due to a recognized lack of historical escapement data, which precludes assessment of the adequacy of the 2006 escapement. At the time of this report, the time series of historical data for the Takotna River weir was not sufficient to apply the Bue and Hasbrouck (2001) method for developing an SEG, for which a minimum of 10 years of escapement data (one life cycle of returns) are generally required (Molyneaux and Brannian 2006). If successful weir operation continues, the 10-year minimum requirement for establishing an SEG will be achieved in 2009, and an SEG will likely be proposed to the Alaska Board of Fisheries in 2010. If investigators choose to also use escapement data collected through the use of counting towers, the minimum data series required for Bue and Hasbrouck application could be as early as 2007 (after 2007 escapement is determined). Using weir- and tower-determined escapement data collected through 2005, the SEG derived from the Bue and Hasbrouck method would range between 1,700 and 5,400, in which most years of escapement would fall near or below the median. The annual variation observed in Takotna River chum salmon escapements may result in changes to this suggested SEG after more years of escapement data are collected.

Commercial harvest pressure on Kuskokwim River chum salmon has been low in the past few years, and the harvest of 44,070 chum salmon in 2006 (Linderman and Bergstrom 2006) probably had negligible impact on individual chum salmon stocks. The number of chum salmon harvested commercially was only a modest fraction of the total number counted past tributary weirs (340,098) and the sonar project in the Aniak River (1,108,626; Figure 18; McEwen *In prep*). Despite relatively high chum salmon escapement at all projects and record high escapements at the Takotna and George river weirs, the commercial harvest of chum salmon was about 25,000 fewer fish than in 2005 and considerably less than the recent 10-year average of 56,279 fish and the pre-2001 10-year average of 216,406 fish (Linderman and Bergstrom 2006). Chum salmon-directed commercial fishing was not permitted during the years immediately following the BOF "stock of yield concern" designation (2001–2003) due to a lack of a commercial market, so annual harvests of just over 1,000 fish were incidental to the coho salmon-directed commercial openings. The low harvests between 2001 and 2003 are partially responsible for the low recent 10-year average (Linderman and Bergstrom 2006). The relatively small harvest in 2006 is likely the combined effect of conservative management and low permit utilization. A lack of commercial markets for chum salmon in recent years has depressed ex-vessel prices and reduced the number of permit holders actively fishing.

As with the commercial fishery, the effect of the subsistence fishery on individual Kuskokwim River chum salmon stocks was probably not significant. Subsistence harvest estimates are not yet available for the 2006 (or 2005), but the 1995–2004 average harvest was 57,981 fish (Martz and Dull 2006). Since annual subsistence harvests have varied little in the past 10 years of available data, the recent 10-year average reasonably approximates the total harvest in 2006. Compared to the number of chum salmon counted past tributary weirs and into the Aniak River in 2006, a subsistence harvest near 60,000 chum salmon probably did not significantly affect escapements of individual stocks. In recent years, chum salmon have generally not been targeted for subsistence use, and the numbers annually harvested since the early 1990s have generally been far less than annual harvests in the 1960s–1980s. In fact, annual subsistence harvests of Chinook salmon have exceeded chum salmon harvests every year since 1993, with the exceptions of 1996 and 2002, despite their lower abundance.

Recognizing the implications of the BOF stock of concern designation, ADF&G implemented a subsistence fishing schedule in 2001 that was intended to distribute subsistence fishing effort more evenly throughout the Kuskokwim River chum salmon run (Molyneaux and Brannian 2006). The subsistence fishing schedule was implemented to mitigate a concern that subsistence fishers in the lower Kuskokwim River were harvesting an unreasonable share of early-running stocks, thereby decreasing the opportunity for fishers further upriver to meet their subsistence needs. Though it was not the focus of the subsistence fishing schedule, ADF&G biologists thought that the diffusion of harvest effort would probably benefit early-migrating salmon stocks. While it was being practiced, the subsistence fishing schedule was being studied for its effectiveness. After several years of implementation, there is now evidence that the fishing schedule was not producing the desired result and has little effect on the timing of subsistence harvest efforts (Toshihide Hamazaki, Commercial Fisheries Biometrician, ADF&G, Anchorage; personal communication). The subsistence fishing schedule has probably provided no benefit to upper river chum salmon stocks such as that bound for the Takotna River.

Run Timing at Weir

Based on median passage dates, the timing of the chum salmon run at the Takotna River weir in 2006 (14 July) was about average and equal to 2000 (Figure 4; Appendix F2). Historically, median passage dates at the Takotna River weir have occurred between 6 July (1996) and 18 July (2003). With central 50% passage occurring over a 15-day period and central 80% occurring over a 27-day period, the chum salmon run in 2006 was similar in duration to previous years. Other Kuskokwim River projects observed median passage dates similar to previous years for chum salmon in 2006; all were near average with no obvious anomalies (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; McEwen et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

Coho Salmon

Abundance

The 5,548 coho salmon reported to have passed upstream of the Takotna River weir during the target operational period of 24 June through 20 September is probably slightly less than the total escapement that passed upstream of the weir site in 2006 because daily passage was still considerable and relatively constant over the last week of weir operations. However, based on historical run timing and escapement information, additional escapement probably would not have amounted to more than a couple hundred fish. Usually by the end of the target operational period daily passage has diminished to only a few fish, making it difficult to estimate what potentially passed after the weir was removed in 2006. The 665 fish estimated to have passed the weir during the brief inoperable period in August constituted only a modest fraction (12.0%) of the total escapement. Though not available in 2006, inriver abundance estimates provided by the *Kuskokwim River Salmon Mark–Recapture Project* between 2001 and 2005 indicate that Takotna River coho salmon comprise about 0.7% of the total return of coho salmon upstream of Kalskag, but the relative contribution varied dramatically from year to year (Pawluk et al. 2006b).

Coho salmon escapement has been determined in all years the weir has operated. Coho escapement was not monitored in the 1990s when escapement was enumerated with counting towers (Molyneaux et al. 2000), so historical data records extend only back to 2000. Escapement in 2006 fell short of only 2003, which was marked by record high coho salmon escapement throughout the drainage (Figure 19; Appendix A3). No formal escapement goals have been established for Takotna River coho salmon, which precludes assessment of the adequacy of the escapement. Escapement was within the escapement goal range at the Kogrukluk River weir, which is the only project with an established escapement goal for coho salmon (Figure 19; Linderman and Bergstrom 2006). The exceptionally high escapement observed at the Takotna River weir in 2006 was not reported elsewhere. Most projects reported average or below average escapements (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; McEwen et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). However, the accuracy of the reported escapement at most projects is unclear because every weir in the Kuskokwim River drainage became inoperative during the period of prolonged precipitation in August, and the escapement determined for most required considerable daily passage estimates.

Escapement goals have not yet been established for Takotna River coho salmon due to a recognized lack of historical escapement data, which precludes assessment of the adequacy of the 2006 escapement. At the time of this report, the time series of historical data for the Takotna River weir was not sufficient to apply the Bue and Hasbrouck (2001) method for developing an SEG range, for which a minimum of 10 years of escapement data (one life cycle of returns) are generally required (Molyneaux and Brannian 2006). If successful weir operation continues, the 10 year minimum requirement for establishing an SEG will be achieved in 2009, and an SEG will likely be proposed to the Alaska Board of Fisheries in 2010. Using weir-determined escapement data collected through 2005, the SEG derived from the Bue and Hasbrouck method would range between 2,600 and 7,200, in which most years of escapement would fall near or below the median. The annual variation observed in Takotna River coho salmon escapements may result in changes to this suggested SEG after more years of escapement data are collected.

Commercial harvest pressure on Kuskokwim River coho salmon has always been considerable. The commercial harvest of 185,598 coho salmon in 2006 (Linderman and Bergstrom 2006) was probably sufficient to noticeably detract from observed escapements at tributary weirs, and likely represents an exploitation rate higher than in recent years. Total inriver abundance estimates are not available for 2006, but results from the *Kuskokwim River Salmon Mark–Recapture Project* indicated that between 2001 and 2005 inriver abundance of coho salmon ranged from 386,743 (2004) to 928,075 (2003) fish. Assuming these estimates are reasonable, they indicate that the number of coho salmon harvested commercially is a significant portion of the total coho salmon run, especially considering that total annual escapements observed at the weir projects were estimated at about 70,000 fish. Since Kuskokwim River coho salmon have not been identified as a stock of concern by the Alaska BOF (Bergstrom and Whitmore 2004), they have not been the focus of conservation measures. Coho salmon-directed commercial fishing has been permitted annually since statehood, but the numbers harvested in recent years have generally remained below harvests in the 1980s through most of the 1990s (Martz and Dull 2006). The recent 10-year average of 369,410 coho salmon in the commercial harvest is lower than all annual harvests between 1986 and 1996. The small harvests in recent years may be partially attributable to relatively low permit utilization and depressed commercial markets for chum salmon.

Contrary to the commercial fishery, the effect of the subsistence fishery on individual Kuskokwim River coho salmon stocks was probably not significant. Subsistence harvest estimates are not yet available for the 2006 (or 2005), but the 1995–2004 average harvest was 31,729 fish (Martz and Dull 2006). Records of coho salmon subsistence harvests have been kept since 1989 and during this time annual subsistence harvests have varied little and the recent 10-year average probably reasonably approximates the total harvest in 2006. Compared to the number of coho salmon captured in the commercial fishery and recognizing that escapement at most projects was near average, a subsistence harvest near 30,000 coho salmon probably did not significantly affect escapements of individual stocks. The exploitation rate of coho salmon for subsistence use is undoubtedly much lower than for Chinook salmon. The subsistence fishing schedule that was implemented annually from 2001 to 2006 had no effect on coho salmon subsistence harvest practices. In each year, the schedule was lifted for the season long before coho salmon were passing through the lower river in significant numbers (Burkey et al. 2002; Ward et al. 2003; Whitmore et al. 2005; Whitmore et al. *In prep*). Indeed, the subsistence fishing schedule was not initiated for coho salmon.

Run Timing at Weir

Based on median passage dates, the timing of the coho salmon run at the Takotna River weir in 2006 (28 July) was the latest on record (Figure 4; Appendix F3). Historically, annual median passage dates have varied little, ranging between 25 and 27 August. With central 50% occurring over a 16-day period and central 80% occurring over a 26-day period, the coho salmon run in 2006 was more protracted than in previous years (Figure 4). In past years, the central 50% and 80% occurred over periods of no more than 14 and 25 days, respectively. Still, the overall pattern of daily passage was markedly similar among the 6 years of enumeration data, and much less variable than at other weir projects (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). As reported, median passage dates have occurred within 4 days during the past 6 years at Takotna River weir, but at other projects with comparable escapement data, median passage dates have been much more variable, ranging up to 17 days at George River weir (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Run timing relative to past years was variable in 2006 at other Kuskokwim River escapement projects, but none witnessed significant anomalies.

Other Species

Sockeye Salmon

Few sockeye salmon are observed in the Takotna River, and the reported escapement of 60 sockeye salmon is considered a reliable estimate of total annual escapement in 2006. Sockeye salmon escapement at the Takotna River weir in 2006 was the highest on record, following a trend of continual escapement increases since 2002 (Figure 20; Appendix B1). Historically, annual sockeye salmon escapement at the Takotna River weir has ranged from 1 fish in 2001 and 2002 to 34 fish in 2005. These low escapements are not surprising since the Takotna River is not a primary spawning tributary for sockeye salmon. Overall, sockeye salmon escapement was above average throughout the Kuskokwim River drainage in 2006, and record-high in some cases (Figure 20; Linderman and Bergstrom 2006).

Sockeye salmon are not abundant in the Kuskokwim River, and not prominent in subsistence or commercial harvests. The 2006 sockeye salmon commercial harvest of 12,618 fish was less than the recent 10-year average of 17,525 fish (Linderman and Bergstrom 2006). Compared to other species in the drainage, little is known about sockeye salmon in the Kuskokwim River. As a result, escapement goals do not exist, and they have not been considered a stock of concern by the BOF.

Historical run timing comparisons are limited by low abundances, but higher abundances in 2005 and 2006 make comparisons between these years appropriate. Based on median passage dates, the timing of the sockeye salmon run in 2006 was slightly earlier than in 2005 (Costello et al. 2006). With central 50% passage occurring over an 11-day period and central 80% occurring over 28-day period, the sockeye salmon run in 2006 was more contracted than in 2005 when the central 50% occurred in 27 days and the central 80% occurred in 40 days. Sockeye salmon run timing at other weirs in the Kuskokwim River drainage was average or slightly earlier than average in 2006 (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

Pink Salmon

Pink salmon are rarely observed in the Takotna River. In fact, the pink salmon that passed upstream of the weir in 2006 was only the second observed in the history of escapement monitoring on the Takotna River; the other was observed in 2002 (Clark and Molyneaux 2003). The probability of finding stray pink salmon in the Takotna River was probably higher in 2002 and 2006 than in other years because both years were characterized by extraordinarily high escapements of pink salmon at the George River weir, and escapement at the Kogrukluk River weir in 2006 was the highest on record for the 23 years with reliable estimates (Hildebrand et al. 2007; Liller et al. *In prep*).

Resident Species

Other species commonly observed at the Takotna River weir include longnose suckers, whitefish, Arctic grayling, and northern pike (Appendix B1). Longnose suckers are historically the most abundant resident species observed in the Takotna River (Appendix B1). During the target operational period, annual longnose sucker passage has ranged from 145 in 2004 to 11,272 in 2001 (Costello et al. 2005; Schwanke and Molyneaux 2002). The passage of 518 fish during the target operational period in 2006 was considerably less than the historical average of 2,776 fish, but that average is heavily influenced by extraordinarily high passage in 2000 and 2001 that have not been achieved since (Schwanke et al. 2001; Schwanke and Molyneaux 2002).

Abundance estimates are known to be incomplete for longnose suckers because smaller individuals may be able to pass freely between the pickets, and upstream migration appears to start well before the target start date for weir operations. Three points suggest that upstream migration starts before the target operational period. First, in years when the weir was operational before 24 June (2005 and 2006), longnose sucker passage before the target start date was much greater than the passage observed during the target operational period. Second, longnose sucker passage tends to be highest during the first few days of weir operations, regardless of whether operations begin on the target start date or 14 days before (2005). Third, larger numbers of longnose suckers are observed migrating downstream in August in September than would have been anticipated based on passage during the target operational period. In 2006, most (55%) of the 1,161 longnose suckers counted upstream through the weir passed before 24 June, emphasizing that the target operational period is not adequate for estimating annual longnose sucker passage and that recorded longnose sucker abundance is more likely influenced by the start date of weir operations than by actual abundance.

Longnose suckers were a prominent species at only two other monitored tributaries in 2006, but the relative strength of the longnose sucker migration varied between the two. At Tatlawiksuk River weir, longnose sucker passage was below average for years with comparable operational dates, but reported longnose sucker passage at George River weir was well above average (Costello et al. 2007; Hildebrand et al. 2007). However, for the reasons cited in the previous paragraph, a significant number of longnose suckers may have passed upstream before operations began, and recorded weir passage generally underestimates the abundance of upstream migrants.

Carcasses

The number of salmon carcasses found on the weir is not a complete census of the number of carcasses that drifted downstream of the weir site (Appendix C1). The sucker chutes installed in late July that are designed to allow downstream migrating suckers to pass over the weir also provide a pathway for post-spawners to pass, and salmon carcasses are commonly observed washing over them. Daily carcass counts noticeably decrease following their installation (Appendix C1). Second, carcass deposition was not estimated for the period when the weir was not operational, so no carcass counts are available for a 4-day period in mid August. Third, the weir was removed long before most of the coho salmon had completed spawning, so the number of coho salmon carcasses counted on the weir probably significantly underestimates the number of post-spawners that drifted past the weir site. Regardless of these confounding factors, *most* of the spawned-out fish were likely retained in or near the river upstream of the weir for a protracted period of time, thereby contributing to the productivity of the system through the addition of marine derived nutrients as described by Cederholm et al. (1999; 2000).

Females comprised 4.0% of the Chinook salmon carcass count compared to the 23.3% derived from ASL sampling and the 20.5% determined from visual sex identification. Similarly, females comprised 29.4% of the chum salmon carcass count compared to the 46.9% derived from ASL sampling and the 51.3% determined from visual sex identification. These results indicate that sex composition derived from weir carcass counts is biased low for females (DuBois and Molyneaux 2000).

AGE, SEX, AND LENGTH COMPOSITION

Chinook Salmon

Sample collection goals were not achieved in 2006, but the modest abundance of Chinook salmon, which is typical of the Takotna River, made the collected sample sizes adequate for estimating total and intra-annual age, sex, and length composition. Sampling effort was spread fairly evenly across the run, and the sample sizes and dates were apportioned into strata such that minimum sample sizes in a stratum were met or exceeded relative to total escapement during the same time. ASL composition has been estimated for the total Chinook salmon escapement in only 3 of 7 years the project has operated. Inadequate samples sizes prohibited total Chinook salmon ASL estimates in 2000, 2001, 2003, 2004, and 2005. Increased abundance and improved sampling techniques resulted in adequate sample collections in 2006.

The abundance of age-1.2 (4 year-old) and -1.3 (5 year-old) Chinook salmon in 2006 was far greater than any previous year with adequate data for total escapement ASL estimates (Table 2; Figure 21; Molyneaux and Folletti *In prep*). These exceptional abundances resulted in a record-high proportional contribution of the age-1.2 component but only an average proportional contribution of the age-1.3 component (Table 2; Figure 5). The proportional contribution of the age-1.4 (6 year-old) component was below average despite relatively average escapement due to the exceptional abundance of age-1.2 fish in 2006 (Table 2; Figure 21). Age-1.5 (7 year-old)

Chinook salmon contribute little to the total escapement at the Takotna River weir, and the 2.6% reported for 2006 was actually higher than all previous years.

In 2006, the proportional contribution of each age class to total escapement in a stratum varied considerably throughout the duration of the Chinook salmon run, but stratified sampling revealed no obvious intra-seasonal trend for any age class (Table 2; Figure 6). This is consistent with Takotna River Chinook salmon data combined over all years and at all other projects in the Kuskokwim River drainage (Figure 6; Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Rarely does an age class consistently increase or decrease during a season, and occasional intra-annual trends observed at one project are generally not consistent throughout the drainage. For example, in 2006 only one project reported a definitive intra-annual decrease in the proportion of age-1.3 Chinook salmon. At all others, the proportion of age-1.3 Chinook salmon remained relatively constant throughout the season (Figure 6). Variations between strata are often greater than the total variation between the first and the last (Molyneaux and Folletti *In prep*).

Historical trends in age composition tend to vary dramatically among projects. The higher-than-average proportion of age-1.2 Chinook salmon observed at the Takotna River weir was also observed at the George, Kogrukluk, and Tuluksak river weirs (Hildebrand et al. 2007; Liller et al. *In prep*; Plumb et al. *In prep*). In contrast, Tatlawiksuk River weir reported a proportion near the historical average, and Kwethluk River weir reported a proportion lower than the historical average (Costello et al. 2007; Miller and Harper *In prep*). Including Takotna River weir, half of the weir projects reported average proportions of the age-1.3 component, but the Kogrukluk and Kwethluk river weirs reported below average proportions and the George River weir reported a proportional contribution considerably above the historical average for that location (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Clearly, historical trends are spatially highly variable. As is usual in the Kuskokwim River drainage, age-1.5 fish constituted only a modest fraction of the overall escapement at all projects in 2006.

Siblings to the cohort that returned in unusually high abundance as age-4 fish in 2004 and age-5 fish in 2005 did not return in unusually high abundance as age-6 fish at the Takotna River weir or any other location in 2006, as evidenced by dominance of the age-4 and age-5 components (Table 2; Figure 21). In fact, most weir projects reported only modest returns of age-6 Chinook salmon in 2006, despite the relatively high abundances of their siblings drainage-wide in 2004 and 2005. In this case, the recognized method of using brood years and sibling relationships to forecast escapement failed to predict the relatively low abundance of age-6 Chinook salmon observed throughout the Kuskokwim River drainage in 2006 (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). However, the high numbers of age-4 fish in 2004 and age-5 fish in 2005 were unexpected because escapements in the 2000 parent year were generally low (Harper and Watry 2001; Linderman et al. 2002; Linderman et al. 2003; Schwanke et al. 2001; Ward et al. 2003). Unfortunately, data are not adequate to calculate return per spawner for the 2000 brood year or any other year, making it difficult to determine with certainty whether total returns in subsequent years were higher than expected (Table 10). Favorable ocean conditions have been cited as a potential driver for the strong returns of the sibling age classes in the last 2 years due to the wide range of the phenomenon and evidence from juvenile salmon studies, and a change in these favorable conditions may have increased mortality of the remaining siblings and explain the surprising modest abundance of age-6 fish in 2006. However, this conclusion is somewhat negated by the return of a remarkable number of age-4 Chinook salmon at the Takotna River weir and other locations that were produced from below average escapements in 2002, suggesting that oceanic survivability remained high over the last winter. The high abundance of age-4 and -5 Chinook salmon in 2006 at the Takotna River weir may foretell strong returns of age-5 and -6 fish in 2007, and since these components generally comprise the bulk of annual escapement, overall Chinook salmon escapement to the Takotna River is expected to be high. By this logic, Chinook salmon escapements to the Kogrukluk and George river weirs should be above average in 2007, but the relative strength of the Chinook salmon run to the Kuskokwim River in 2007 can not be accurately predicted recognizing the high variability of age-class specific run strength among Kuskokwim River projects.

At 23% of the total escapement, the percentage of females determined through ASL sampling estimates at Takotna River weir in 2006 was similar to previous years with adequate data for comparison (Molyneaux and Folletti *In prep*). Stratified sampling revealed little change in sex composition between the first 2 of 3 sampling strata, but female percentage increased dramatically during the last phase of the Chinook salmon run (Table 2; Figure 7). This trend of higher female percentage near the end of the run is consistent with historical Takotna River weir ASL data combined over all years (Figure 7) and with other tributaries in the drainage where samples have been collected (Molyneaux and Folletti *In prep*). In the Kuskokwim River, male Chinook salmon tend to migrate earlier than females. Similar to age composition, the percentage of females in overall escapement varies dramatically spatially and temporally; rarely is a trend at one location observed at another. Sex composition relative to past years was variable among projects in 2006. Takotna River weir observed a sex composition that was similar to previous years, but this pattern was not consistent among all projects in the area.

Suspecting that sex composition estimates from ASL sampling may be biased due to the trap structure, investigators began enumerating passing Chinook salmon by sex in 2005 (Costello et al. 2006). For Chinook salmon, the method of visually identifying the sex of every passing fish is considered a more accurate method for determining sex composition in tributaries with low turbidity; however, this method does not provide the means to tie sex with length and age. Though data are lacking for historical comparisons, the practice of visually identifying the sex of every passing Chinook salmon provides an opportunity to investigate potential sex bias in the total estimated escapement as well as in each individual temporal stratum. Though both methods revealed a similar intra-annual trend of increasing female percentage in 2006, and both resulted in a similar total escapement sex composition estimate, they showed considerable disparity in the last stratum (Figure 8). During the last stratum, the female percentage determined through regular passage counts was nearly 30% higher than the estimate derived from ASL sampling. Towards the end of the run, the female percentage estimate provided by ASL sampling is thought to be biased low. This disparity may be due to the protracted length of the last sampling strata relative to the sample dates. Considering that females tend to migrate later than males and the protracted period of time the last pulse sample was supposed to represent, the dates of the last pulse sample may have been insufficient to fully capture the phenomenon of increased female percentages at the end of the run.

Mean lengths for each age and sex category were similar to past years with sufficient data for comparison (Figure 22), but Takotna River Chinook salmon did exhibit length partitioning by age class for male and female fish, a pattern commonly observed throughout the Kuskokwim

River drainage (Table 3; Molyneaux and Folletti *In prep*). As expected, mean length increased with age. Intra-annual length trends were generally weak in 2006. Mean lengths of all age/sex categories remained relatively constant throughout the duration of the Chinook salmon run (Figure 9). Chinook salmon rarely show an obvious intra-annual trend in lengths by age class at Takotna River weir or elsewhere in the Kuskokwim River drainage, and apparent trends tend to be weak and their significance is unknown. However, one obvious conclusion is that female Chinook salmon were generally larger, on average, in both -1.3 and -1.4 age classes (Table 3).

ASL data obtained from the commercial and subsistence catches allow for comparison and a better understanding of total run dynamics. Annual ASL compositions of weir escapement must be considered with respect to the ASL compositions of the subsistence and commercial fisheries that harvest a portion of the stock returning to each tributary. The mesh-size restriction imposed on commercial fishers is intended to limit the number and size of Chinook salmon harvested in the commercial fishery. As intended, average lengths of Chinook salmon in the commercial harvest are significantly less than those in the subsistence harvests and weir escapements (Figure 23; Molyneaux and Folletti *In prep*). Since smaller fish tend to be younger fish, commercial fishery harvests tend to consist mainly of age-1.2 fish under this restriction (Figure 23). Proportional contribution of total commercial catch decreases steadily with increasing age, so that age-1.3 and -1.4 Chinook salmon comprise much smaller fractions of total harvest despite their relatively high abundance in tributary escapements (Molyneaux and Folletti *In prep*). Since few age-1.2 and -1.3 Chinook salmon are females, and length-at-age tends to be greater among females, the commercial fishery inadvertently targets mostly males (0.93 in 2006; Molyneaux and Folletti *In prep*). However, the impact on the commercial fishery to ASL composition of tributary escapement has probably been negligible in recent years due to relatively small commercial harvests.

The subsistence fishery has no limitations on mesh size and most subsistence fishers use nets with a mesh size of 8 inches (stretched mesh) or greater (Martz and Dull 2006). Most fishers use this type of gear because it reduces the harvest of chum salmon which are not generally preferred. This apparent species selectivity is actually a function of size selectivity; large-mesh gear is not effective at capturing large quantities of chum salmon because their smaller size allows them to escape the net. Logically, Chinook salmon similar in size to chum salmon are less likely to be captured, so the use of large-mesh gillnets effectively induces size selectivity of Chinook salmon. Since Chinook salmon exhibit length partitioning by age and sex, and older fish tend to be females, the use of large-mesh gillnets inflates the harvest of older fish, larger fish, and females above the proportions thought to occur in the natural population (Molyneaux and Folletti *In prep*). This selectivity is responsible for most of the disparity between ASL compositions of the subsistence harvest and weir escapement, but these disparities are likely exacerbated because the quantity of Chinook salmon removed through the subsistence harvest is probably large enough to affect the composition of escapements observed at tributary weirs. As a result, average length of the escapement to a given tributary weir is thought to be somewhat less than the average length of the total return bound for that tributary. Conversely, the proportion of younger age classes and males in tributary escapements are thought to be higher than in the total return.

Chum Salmon

The ASL data collected from chum salmon in 2006 were adequate for describing the age composition for the total annual escapement. Sampling was conducted periodically throughout the run and total sample size met or exceeded the minimum goal for each pulse. ASL composition has been estimated in all 7 years the project has operated.

The proportion of age-0.3 (4 year-old) chum salmon in 2006 (62.2%) was similar to most past years, but the abundance of this age class was higher than all previous years (Table 4; Figure 21). Generally, unusually high abundances of age-0.3 fish were reported throughout the drainage in 2006, but proportions remained near or slightly below average due to the record high abundances of age-0.4 (5 year-old) chum salmon that were reported throughout the drainage (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Millerand Harper *In prep*; Plumb et al. *In prep*). Reciprocally, the proportion of age-0.4 chum salmon remained near average at Takotna River weir and most other projects in the Kuskokwim River drainage due to the unusually high abundance of age-0.3 fish (Table 4; Figure 21). Other age classes, such as age-0.2 (3 year-olds) and -0.5 (6 year-olds), comprised an insignificant fraction of escapement at all projects in the Kuskokwim River drainage in 2006, comprising no more than 3.5% and 0.4% of escapement, respectively, at all projects (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

In 2006, the proportional contribution of each age class to total escapement in a stratum varied considerably throughout the duration of the Takotna River weir chum salmon run. As reported, the proportion of age-0.3 chum salmon continually increased during the run while the proportion of age-0.4 fish continually decreased (Table 4; Figure 10), which is a trend consistent with Takotna River weir chum salmon age composition combined over all years. This inverse relationship between the proportion of age-0.3 and -0.4 chum salmon is commonly observed throughout the Kuskokwim River drainage, and all projects reported a similar trend in 2006 (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

The record high abundance of age-5 chum salmon at Takotna River weir and all other locations in the Kuskokwim River drainage was expected following the record high abundance of their age-4 siblings in 2005, but neither phenomenon was anticipated following the relatively low escapements recorded drainage-wide during the 2001 brood year (Figure 18; Burkey et al. 2002). Though the total return from the 2001 brood year will not be known until after the age-6 fish return in 2007, the return per spawner ratio can be reasonably determined excluding this information because age-6 fish typically comprise such a tiny fraction of total annual escapement (Table 11; Molyneaux and Folletti *In prep*). The resulting ratio of 1.9 returning fish per spawner for the 2001 brood year is much higher than the 0.8 calculated for 2000, but similar information is not available for other years at the Takotna River weir. The only other brood year for which total return was calculated was 1997, but the accuracy of the escapement estimate and the resulting return per spawner ratio of 3.6 for this year is unknown because it was based on tower counts and not weir passage (Table 11). Since 1 year of incomplete escapement or ASL sampling estimates will result in 4 years without sufficient data to calculate brood year return, few other projects in the drainage have consistent records of return per spawner. Kogrukluk River weir likely has more records than any other Kuskokwim River project, and at that location return per spawner is highly variable, ranging from 0.4 to 3.8 returning fish per spawner (Liller et al. *In prep*). Nevertheless, the high abundance of age-4 chum salmon at the Takotna River weir and throughout the drainage was expected following a year of above-average age-3 abundance in 2005, and may foretell a strong return of age-5 chum salmon in 2007 (Figure 21). Unfortunately, the drainage-wide predictive value of the age-3 age class in 2006 is uncertain due to the spatial variability in the relative abundance of this age class. At the Takotna River weir, the abundance of age-3 chum salmon was above average but half that of 2005, suggesting that their siblings will return in above average abundance as age-4 fish in 2007, but not near the record-high escapement of this age observed in 2006. Assuming oceanic survivability remains relatively constant, logic dictates that age-5 fish will likely return in high abundances in 2008. However, this speculation is not valid for other tributaries that reported average or below average escapements of age-3 chum salmon in 2006, such as the Tatlawiksuk River weir where reported abundance of age-3 chum salmon was considerably lower than in recent years (Costello et al. 2007). These locations will likely observe relatively low escapements of age-4 chum salmon in 2007 as the siblings to the 2006 age-3 cohort return as age-4 fish. In summary, the strength of the 2007 chum salmon run at Takotna River weir will likely be high, and much higher than escapements that contributed to the BOF stock of concern designation.

At nearly 47% of the total escapement, the percentage of females at the Takotna River weir was only slightly below average (Molyneaux and Folletti *In prep*). Female percentage varied dramatically among projects, ranging from as little as 36.8% at the Salmon River weir (Aniak River drainage) to 57.5% at the George River weir (Hildebrand et al. 2007; Molyneaux and Folletti *In prep*). Though the Takotna River weir and two other projects reported female percentages that were slightly below average, two others reported female percentages just above average, and still two more reported percentages near average, which demonstrates the high degree of variability in sex composition. As the run progressed, the proportion of females tended to increase, which was a pattern common to most locations in 2006 (Table 4; Figure 7). Kwethluk and Salmon river weirs were the only notable exceptions (Miller and Harper *In prep*; Molyneaux and Folletti *In prep*).

Suspecting that sex composition estimates from ASL sampling may be biased due to the trap structure, investigators began enumerating passing chum salmon by sex in 2005 (Costello et al. 2006). For chum salmon, the method of visually identifying the sex of every passing fish is considered a more accurate method for determining sex composition in tributaries with low turbidity. Though data are lacking for historical comparisons, the practice of visually identifying the sex of every passing chum salmon provides an opportunity to investigate potential sex bias in the total estimated escapement as well as in each individual temporal stratum. In 2006, both methods revealed a similar intra-annual trend of increasing female percentage and both resulted in a similar total escapement sex composition estimate (Figure 8). Unlike for Chinook salmon, significant disparity between the two methods was not observed in either the total escapement, or by stratum (Figure 8). In 2006, age composition estimates provided by ASL sampling was considered accurate.

Annual mean lengths of Takotna River weir chum salmon in each age and sex category have varied considerably from year to year, but no consistent trend is apparent. Mean lengths of male and female age-0.3 chum salmon have remained similar since 2004, but the mean lengths over the last 3 years were generally below those recorded from 2001 to 2003 (Figure 24). In fact, annual mean lengths of age-0.3 chum salmon, both males and females, have been similar in recent years to 2000 (Figure 24). Similarly, mean lengths of both male and female age-0.4 chum salmon in recent years (2004 and 2006) have been below those reported earlier in the project's history, but this older age class has a higher degree of variability and smaller sample sizes (Figure 24). Historical length trends have shown a high degree of spatial variability in the Kuskokwim River drainage. In recent years, a similar trend of lower-than-average mean annual length for all age and sex categories has been observed at Tatlawiksuk, George, and Kogrukluk river weirs, the three monitored tributaries geographically nearest the Takotna River (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep)*. Monitoring locations further downstream, such as Aniak Sonar Project and Tuluksak and Kwethluk river weirs, have not observed any discernible historical trend and generally mean lengths in 2006 were near historical averages for given age and sex categories (McEwen et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). Regarding intra-annual length trends in 2006, mean lengths tended to increase with age, males tended to be larger than females at a given age, and mean length-at-age tended to decrease over the course of the chum salmon run in 2006 (Figure 11). Such patterns tend to be common at the Takotna River weir and other locations where ASL samples have been collected (Molyneaux and Folletti *In prep*).

Coho Salmon

The ASL data collected from coho salmon in 2006 were adequate for describing the age composition for the total annual escapement. The sampling goal of three temporally well distributed pulses each with 170 fish was achieved in 2006 (Table 6). ASL composition has been estimated in all 7 years the project has operated.

The coho salmon run at Takotna River weir in 2006 was composed almost entirely of age-2.1 (4 year-old) fish, which is always the most dominant age class in the Takotna River and throughout the Kuskokwim River drainage (Molyneaux and Folletti *In prep*). Escapement of the 2.1 age class was nearly the highest on record, falling short of only 2003 when coho salmon escapements throughout the Kuskokwim River drainage achieved record-high levels (Figure 19). At Takotna River weir, record high abundance and proportion of age-1.1 (3 year-old) coho salmon maintained the proportion of age-2.1 at a level near the historical average despite a relatively weak return of age-3.1 (5 year-old) fish, which is typically the second most abundant age class annually (Figure 5; Molyneaux and Folletti *In prep*). The high abundance of age-2.1 fish relative to historical levels was not observed in other Kuskokwim River tributaries where samples were collected in 2006, but low relative abundances of the other age classes maintained the proportion of age-2.1 fish near average at these projects. In fact, most projects reported below average abundances of age-2.1 fish, which ultimately translated into average or below average overall escapements (Molyneaux and Folletti *In prep*). Drainage-wide, the proportion of age-3.1 coho salmon was below average whereas the proportion of age-1.1 fish was above average, with the exception of Kwethluk River weir where the reported proportions of these age classes were near average (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*). No other age classes are commonly found in the Kuskokwim River drainage.

In 2006, the proportional contribution of each age class to total escapement in a stratum varied little throughout the duration of the Takotna River weir coho salmon run, but a slight increase in the proportion of age-2.1 fish was observed from early to late in the run (Table 6). Though little change was observed in the other age classes, the proportion of age-1.1 fish peaked early and the proportion of age-3.1 fish peaked towards the middle of the run. Strong intra-annual trends in age composition are not usually found in Kuskokwim River tributaries, and minor changes in proportion between strata do not translate into significant trends at the Takotna River weir or at other projects in the drainage (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*; Miller and Harper *In prep*; Plumb et al. *In prep*).

Sibling relationships are of little value for predicting run strength of coho salmon because the vast majority of coho salmon return to spawn as 4 year-old fish, and the number of age-3 fish is rather insignificant in comparison. An “unusually strong showing” of age-3 fish might equate to nothing more than 3.4% of the escapement (such as at the Takotna River weir in 2006), so using the proportion and abundance of age-3 fish 1 year to predict the proportion and abundance of age-4 fish the next year will have little value. Another method is simply looking at the abundance during the brood year, but this method does not account for confounding factors such as commercial and subsistence harvest, or predation or competition while in the ocean. Return per spawner information is generally lacking despite outstanding operational performance at the Takotna River weir because 3 years of age-specific abundance data are required to estimate the total return from a brood year 5 years before, which emphasizes the need for an extensive and reliable historical data set (Table 12). With existing data, return per spawner can only be calculated for the 2000 and 2001 brood years, both of which produced nearly identical returns per spawner (Table 12). Still, the high escapement observed at the Takotna River weir was expected because escapement during the 2002 brood year was above average.

At nearly 45% of the total escapement, the percentage of females at Takotna River weir was about average for that weir (Molyneaux and Folletti *In prep*). In 2006, female percentage varied dramatically among projects, ranging from as little as 36.9% at the Kwethluk River weir to 55.0% at the George River weir (Hildebrand et al. 2007; Miller and Harper *In prep*). However, most projects observed a male to female ratio close to 1:1 in 2006, which is historically consistent. As with age composition, sex composition tends to vary less, both spatially and temporally, in coho salmon than in other species (Table 6; Figure 7).

To investigate potential bias in the age composition estimate provided through ASL sampling, investigators began counting coho salmon by sex in 2005 (Costello et al. 2007). Coho salmon sex tends to be more difficult to determine than for other species due to a lesser degree of sexual dimorphism. Investigators hoped that by using both methods to estimate sex composition, intra-annual trends would become more apparent and confidence would be increased if the two methods supported each other. Both methods resulted in a similar sex composition estimate for total escapement, and in each temporal stratum, indicating that estimates resulting from both methods are probably fairly accurate (Figure 8). Furthermore, the trend of increasing female percentage during the run was supported by both methods, a fact that improves investigators’ confidence in the presence of the trend (Figure 8).

Annual mean lengths of male and female age-2.1 coho salmon at the Takotna River weir in each age and sex category have varied considerably from year to year, and in general have been declining since 2001 (Figure 25). In 2006, the mean lengths of age-2.1 males and females were significantly less than in previous years (Figure 25). Mean lengths of age-2.1 male and female coho salmon were considerably below average at every sampled location in the Kuskokwim River drainage in 2006 (Molyneaux and Folletti *In prep*). In fact, the mean lengths of male age-2.1 coho salmon were significantly below all previous years at the Kogrukluk River weir, and below nearly every previous year at the George River weir. Additionally, mean lengths for female age-2.1 coho salmon were significantly below all previous years at these locations. At Takotna River weir in 2006, length partitioning was not observed among age classes or between sexes (Table 7). Length partitioning among age classes or between sexes is not generally observed in Kuskokwim River tributaries, and the small differences occasionally observed tend to be artifacts of small sample sizes.

WEATHER AND STREAM OBSERVATIONS

Water level in the Takotna River was above average for nearly the entire operational period and the mean water level was the highest on record (Figure 13). In general, mean daily water levels remained above the historical average but within the historical range for all of June through the first half August, but beginning on 18 August and continuing through 5 September mean daily water level generally exceeded historical levels. Water temperature at the Takotna River weir was well below average for most of the season, falling below previous historical minimums for a brief time in late June and mid July (Figure 13). Water temperature after 22 August tended to increase slightly as water levels dropped following the record-high flood event, eventually exceeding the historical average around 8 September and historical maximums around 13 September (Figure 13).

Any relationship between water level (or water temperature) and passage strength or timing is not easily discernible by the available data because daily weir operation and ASL sampling effort is not consistent and salmon passage can be influenced by the timing and duration of counting sessions, the level of ASL sampling activity, and cleaning and repair efforts (Figures 14 and 15). If the study was designed for these activities to be consistent, the effect of water level on salmon passage may be better revealed. There did not appear to be a strong correlation between daily water level and salmon passage.

Knowledge of environmental conditions and a commitment to long-term monitoring may be valuable in understanding migration and survival. Quinn (2005) notes that migration in salmon is likely controlled by genetic factors as an adaptation to long-term average environmental conditions. Keefer et al. (2004) found a positive correlation between river discharge and run timing of Columbia River Chinook salmon stocks, and that Columbia River sockeye salmon have started their inriver migration 2 weeks earlier in response to warmer water conditions resulting from dam construction. We cannot begin to assess the affects of changing environmental conditions on Kuskokwim River salmon without the relatively complete weather and stream observations collected by weir crews such as at the Takotna River. Escapement projects must continue to be diligent in the collection of weather and stream data. Perhaps with sufficient data, researcher and managers will be able to assess relationships between migration and environmental factors relevant in the broader spatial-temporal context.

JUVENILE SALMON INVESTIGATIONS

Sampling Efforts

Juvenile sampling in 2006 was limited by funding shortfalls and crew availability. Unusually strong Chinook and chum salmon runs necessitated crew attention, and staff changes limited the flexibility of experienced crewmembers. Juvenile studies remain a secondary objective for the Takotna River weir, and the primary objectives often required the crew to remain near the weir.

Distribution

The only significant finding of the 2006 juvenile investigations was the absence of juvenile Chinook and coho salmon in Moore Creek where they were found in 2005. In 2005, a total of 888 trap-hours in Moore Creek yielded 8 Chinook and 33 coho, resulting in a juvenile Chinook CPUE of 0.01 fish per trap-hour and a juvenile coho CPUE of 0.04 fish per trap-hour (Tables 8 and 9). Similar effort was focused in Moore Creek in 2006, but no salmon of any species were captured (Tables 8 and 9; Appendix E1). The absence of juvenile Chinook and coho salmon catches from Little Waldren Fork (Index Area 10) and Minnie Creek (Index Area 7) was not surprising because historically only 1 Chinook and no coho salmon have been captured in these locations (Tables 8 and 9).

The differences in catch between 2005 and 2006 in Moore Creek was likely caused by the time of year sampling was conducted. In 2005 sampling was conducted in Moore Creek in mid-September, not early in the summer as in 2006. Unfortunately, low water conditions prevented sampling in this location at other times in 2005. In past years, virtually no salmon have been captured in Moore Creek during June trapping events. This relationship between location and time of year suggests temporal changes in habitat utilization.

Virtually no salmon have been captured in Moore Creek during June trapping, but in 2001 a total of 86 juvenile coho salmon were captured in this location using a beach seine (Table 9; Schwanke and Molyneaux 2002). It is difficult to discern whether these catch differences are due to temporal changes in habitat utilization, size selectivity of gear types, or effectiveness of capture methods. Regardless of the cause, such disparities confirm that one gear type can not be used as a surrogate for another.

RELATED FISHERIES PROJECTS

Inriver Abundance of Chinook Salmon in the Kuskokwim River

The Takotna River weir project contributed successfully to *Inriver Abundance of Chinook Salmon in the Kuskokwim River.* Though no radio tagged salmon were detected from this station, records of reference tag transmission indicated that the receiver station functioned properly throughout the season.

Efforts in 2006 mark the fifth year that an abundance estimate was determined for the Kuskokwim River drainage upstream of the Aniak River confluence, but the first year that an abundance estimate could be calculated that includes the Aniak River. In past years, the Aniak River was excluded from the drainage-wide abundance estimate due to potential bias associated with bank orientation (Stuby 2003, 2004, 2005, 2006, *In prep*). Experimental design was modified annually in an effort to mitigate this bias, but such efforts tended not to be effective. The installation of a weir on the Salmon River in 2006 provided a marked to unmarked ratio that could be expanded for the entire Aniak River drainage, thereby providing an estimate for that drainage as well as an estimate for the entire drainage upstream from the Kalskag tagging sites. The resulting estimate for the Aniak River of roughly 68,000 fish represented about 29% of the total abundance estimate for waters upstream of Kalskag (Stuby *In prep*).

As evident from ASL data collected throughout the Kuskokwim River drainage, few Chinook salmon in the Kuskokwim River are smaller than 450 mm. Samples collected from the Takotna, George, Kogrukluk, and Tatlawiksuk river weirs suggest that Chinook salmon less than 450 mm in length comprise only a small fraction of total escapement (Costello et al. 2007; Hildebrand et al. 2007; Liller et al. *In prep*). At the Takotna River weir in 2006 these small Chinook salmon only comprised about 2% of total escapement. Other weirs reported much lower percentages. These data suggest that the inriver abundance estimate of only Chinook salmon larger than 450 mm is probably close to the total abundance of all Chinook salmon.

Kuskokwim River Sockeye Salmon Investigations

The Takotna River weir project contributed successfully to *Kuskokwim River Sockeye Salmon Investigations*. Though no radiotagged salmon were detected from this station, records of reference tag transmission indicated that the receiver station functioned properly throughout the season.

Sockeye salmon have been documented in several other tributaries throughout the Kuskokwim River basin (Burkey and Salomone 1999), but little is known about these populations. Rearing ecology of these “river-type” sockeye salmon is not well understood in the Kuskokwim Area, though river-spawning behavior among sockeye salmon is documented in other areas of both Asia and North America (Burgner 1991). Wood et al. (1987) found that “river-type” sockeye salmon contributed from 39% to 48% of total sockeye salmon returns to the Stikine River in 1984 and 1985. The contribution of these “river-type” sockeye salmon to the overall Kuskokwim River sockeye salmon production could be substantial. Further research addressing the biology and ecology of Kuskokwim River sockeye salmon will be essential to narrow current knowledge gaps and ensure successful management of a sustainable sockeye salmon fishery.

Kuskokwim River Salmon Mark–Recapture Project

The Takotna River weir project contributed successfully to the *Kuskokwim River Salmon Mark–Recapture Project*, which afforded an opportunity to study migration characteristics of Takotna River Chinook and sockeye salmon in 2006. Efforts in 2006 mark the sixth year that mark–recapture has been used to assess run timing and travel speed. Details are discussed by Baumer et al. (*In prep*).

Chinook Salmon

No tagged Chinook salmon were observed at the Takotna River weir in 2006, which precludes assessment of travel speed and run timing. This was not unexpected because Chinook salmon escapement past the Takotna River weir is modest compared to escapement at other projects and anchor tagging efforts in 2006 were reduced from 2005 (Baumer et al. *In prep*). Non-radiotelemetry mark–recapture has only been conducted for Chinook salmon in 2005 and 2006; the procedure of assessing run timing and travel speed of Chinook salmon using anchor (or spaghetti) tags was not an objective of the mark–recapture project prior to 2005. Data from the 2 anchor-tagged fish that were recaptured in 2005 are not considered adequate to justify temporal or spatial comparisons.

Sockeye Salmon

The data obtained from the single tagged sockeye salmon recaptured at the Takotna River weir can not be assumed to represent the migratory behavior of the entire sockeye salmon escapement when considered alone, but data from past years and other measures of run timing support the assumption that the late run timing through the lower river exhibited by the recaptured individual in 2006 reflects the run timing of all the sockeye observed passing the Takotna River weir in 2006. The late lower-river run timing exhibited by the tagged individual in 2006 is consistent with historical records from 2004 and 2005, which is perhaps the most compelling evidence that sockeye salmon bound for the Takotna River tend to migrate through the lower river later than other stocks (Baumer et al. *In prep*). Furthermore, the consistently late at-the-weir run timing exhibited by Takotna River weir sockeye salmon escapement implies a propensity for late run timing in general. This latter argument is supported by trends in travel speed revealed through recaptured tagged sockeye salmon at the Takotna River weir and elsewhere in the drainage.

Information obtained from tagged sockeye salmon throughout the Kuskokwim River drainage reveals a consistency in average travel speed (about 25 km/day) regardless of tributary location (Baumer et al. *In prep*). Assuming that sockeye salmon bound for the Takotna River travel at about this speed, fish migrating from the Kalskag tagging site would require about 27 days to travel to the weir. In effect, the dates of median passage at the weir, 17 August in 2004 and 2005 and 15 August in 2006, should have occurred approximately 27 days after the median passage date of these populations past the tagging sites, on roughly 21 July in 2004 and 2005, and 19 July in 2006. Plotting these points against datasets from tag recoveries at other weirs still supports the conclusion that sockeye salmon bound for the Takotna River are among the latest to travel through the lower river. Though data are lacking, travel speeds of the few tagged sockeye salmon recaptured at the Takotna River weir over the years have generally exceeded this 25 km/day average, which is consistent with the observed trend that travel speed increases with later run timing, and ultimately would indicate a later lower-river run timing than speculated based on the average travel speed observed elsewhere.

From an area-wide perspective, the run timing information derived from pooling the tag samples from *Kuskokwim River Salmon Mark–Recapture Project* and *Sockeye Salmon Investigations* indicates considerable variation in stock-specific run timing in 2006 (Baumer et al. *In prep*).

CONCLUSIONS

ESCAPEMENT MONITORING

- The weir was installed by 17 June and was operational until 23 September.
- The effect of the 4-day inoperable period between 19 and 22 August on salmon escapement is not considered significant.
- Total annual Chinook salmon escapement in 2006 was considerably higher than in 2000, and annual Chinook salmon escapements have been increasing steadily but gradually since 2002 though they have not yet surpassed the record high escapements in 1997 and 2001.
- The increase in Chinook escapement between 2005 and 2006 was not observed in most other tributaries or reflected in the composite index but it was reflected in the annual inriver abundance estimates provided through the radio tagging effort.
- The commercial fishery probably had a negligible impact on the Chinook salmon escapement, but the subsistence fishery likely had a considerable impact.
- At-the-weir run timing of Chinook salmon at the Takotna River weir was later than average, which was a trend observed throughout the drainage.
- Comparison with aerial surveys of the Salmon River (Pitka Fork) reveals that the Takotna River weir is not a reasonable index of abundance in the Salmon River.

- Total annual Takotna River weir chum salmon escapement in 2006 was the highest on record and about 10 times higher than in 2000. Annual chum salmon escapement has been increasing dramatically since 2004 following 4 years of declining escapements.
- Chum salmon escapements at the Takotna River weir and most other locations in recent years have been relatively high.
- The commercial and subsistence fisheries probably had a negligible impact on the chum salmon escapement.
- At-the-weir run timing of chum salmon at the Takotna River weir was near average, which was a trend consistent with other escapement monitoring projects in the Kuskokwim River drainage.
- Total annual Takotna River weir coho salmon escapement in 2006 was the second highest on record, being surpassed only by 2003. Annual coho salmon escapements have been variable at Takotna River weir and other locations in the Kuskokwim River drainage, but the relatively high escapement observed at the Takotna River weir in 2006 was not observed elsewhere.
- The commercial fishery probably had a considerable impact on coho salmon escapement, but the subsistence fishery probably had virtually no impact.
- At-the-weir run timing of coho salmon at the Takotna River weir was the latest on record, which was not observed at other locations in the drainage.
- Sockeye salmon escapements to the Takotna River weir have been increasing since 2002 but they do not yet constitute a large fraction of total escapement.
- Pink salmon are rare in the Takotna River; only 2 have been observed in the history of the project.
- Historical escapement records are not sufficient to develop escapement goals for Chinook, chum, or coho salmon at this time, but by 2010 escapement data should be sufficient for escapement goal development if the weir continues to operate successfully through 2009.
- The weir is not an effective way of enumerating carcass fall out or estimating sex composition of upstream escapement.

AGE, SEX, AND LENGTH COMPOSITION

- Post-season analysis revealed that ASL sample collections for Chinook, chum, and coho salmon were sufficient for estimating the age, sex, and length composition of total annual escapement.
- The abundances of age-4 and -5 Chinook salmon at Takotna River weir in 2006 were greater than any other year, but the abundance of age-6 fish was about average.
- Age-6 Chinook salmon were expected to be more abundant than what was observed in 2006 based on the abundance of their siblings in 2004 and 2005.
- Chinook salmon escapement to the Takotna River weir is expected to be high in 2007 based on the high abundance of age-4 and age-5 fish in 2006.

- The sex ratio of Chinook salmon at the Takotna River weir in 2006 was similar to previous years and continues to be male-biased. The newly employed method of visually identifying the sex of every passing fish corroborates the sex bias deduced from ASL sampling.
- Chinook salmon were similar in length to previous years in all age/sex classes and changed little throughout the duration of the run.
- Despite the exclusive use of small-mesh gear, the commercial fishery probably had no effect on the ASL composition of Takotna River weir Chinook salmon escapement, but the dominant use of large-mesh gear in the subsistence fishery likely affected the ASL composition of weir escapement.
- The abundances of age-4 and -5 chum salmon at Takotna River weir in 2006 were greater than any other year while the abundance of age-3 and -6 fish was below average.
- The relatively high abundance of age-5 chum salmon was anticipated given the record high abundance of their age-4 siblings in 2005. However, neither phenomena were anticipated following the low abundance recorded drainage-wide during the 2001 brood year.
- The male-to-female sex ratio of chum salmon at the Takotna River weir in 2006 was slightly below average but close to 1:1. The newly employed method of visually identifying the sex of every passing fish corroborates the sex ratio determined from ASL sampling.
- Mean lengths of age-4 chum salmon at the Takotna River weir have remained similar in recent years but generally below lengths in 2001 to 2003. Similarly, age-5 chum salmon at the Takotna River weir have remained similar in recent years but generally below the lengths reported earlier in the project's history.
- The commercial and subsistence fishery probably had little to no effect on the ASL composition of Takotna River weir chum salmon escapement.
- The abundances of age-3, and -4 coho salmon at Takotna River weir in 2006 were above average other year, but the abundance of age-5 fish was below average.
- Return-per-spawner information is not sufficient to assess the relative strength of coho salmon returns to the Takotna River in 2006.
- The male to female sex ratio of coho salmon at the Takotna River weir in 2006 was similar to previous years and continues to be nearly 1:1. The newly adopted method of visually identifying the sex of every passing fish corroborates the sex bias deduced from ASL sampling.
- Only age-2.1 coho salmon return to the Takotna River weir in high enough abundance to compare historical mean lengths, and the mean lengths of both males and females of this age class were significantly below all previous years. Below-average size of age-2.1 coho salmon was a common trend throughout the Kuskokwim River drainage.
- The Takotna River coho salmon run did not exhibit length partitioning by age or sex.

WEATHER AND STREAM OBSERVATIONS

- For most of the 2006 season, daily water levels were above average and exceeded historical daily levels in late August and early September.
- Daily water temperatures at the Takotna River weir in 2006 were generally near or below average, exceeding historical daily maximums only near the end of the operational period.
- No obvious relationship was observed between fish passage and water level or water temperature.

JUVENILE SALMON INVESTIGATIONS

- The most significant finding in 2006 was the absence of juvenile Chinook and coho salmon in Moore Creek where they were found in relatively high abundance in 2005.
- No juvenile salmon were captured to measure for length.

RECOMMENDATIONS

ESCAPEMENT MONITORING

- Annual operation of the Takotna River weir should continue indefinitely because this project provides the only monitoring of chum and coho salmon escapements in the upper Kuskokwim River basin, and it is the only ground-based monitoring for Chinook salmon in the upper Kuskokwim River basin. Further, salmon from Takotna River weir have consistently had the earliest run timing through the subsistence and commercial fisheries of the lower Kuskokwim River (Kalskag and Aniak) as determined through drainage-wide tagging programs. The timing of Takotna River salmon appears to apply more broadly to upper Kuskokwim River Chinook, summer chum, and coho salmon spawning populations. These early running populations are subject to intensive harvest in lower Kuskokwim River subsistence and commercial fisheries at a time when fisheries managers have the least information to assess run abundance; consequently, these early running populations are at greatest risk of management error. The Takotna River weir provides the only basis for assessing the impacts of harvest patterns and the adequacy of upper Kuskokwim River escapements.
- The Takotna River weir should continue to be operated jointly by the TTC and ADF&G. The TTC crew is fully capable at operating the weir with the guidance of an ADF&G crew leader, but TTC lacks capacity for conducting postseason data analysis and report writing. The mutually dependent partnership has created a level of dialogue and synergy that benefits both organizations, as well as the public. Formal and informal discussions that have arisen through the presence of ADF&G staff at Takotna and McGrath have created a level of public awareness about salmon management and stock status that did not previously exist. The interaction has also created a heightened level of trust between the public and ADF&G that should be recognized and encouraged.
- As opportunity allows, crew members should consider installing the substrate railing late in the spring to take advantage of low water levels in the Takotna River, thereby hopefully avoiding the delay in operation experienced in 2003. All members of the TTC

crew are resident at Takotna, making the likelihood of effective timing of an early installation highly plausible.

- Establish SEG ranges as soon as adequate data is obtained. SEG ranges serve as a means to assess the adequacy of annual escapement, and are goals fishery managers can work to achieve. The minimum 10-years of sound escapement data required by the commonly used Bue Hasbrouck Model (Bue and Hasbrouck 2001) should be achieved by 2009 for Chinook, chum, and coho salmon. Assuming successful weir operation continues, ADF&G should propose SEG ranges to the Alaska BOF during the 2010 meeting.

AGE, SEX, AND LENGTH COMPOSITION

- Project leaders and collaborators should adjust sample size objectives for Chinook salmon ASL sampling at the Takotna River weir because the target sample size of three 210-fish samples typically exceeds the annual escapement at the weir.
- Future project reports for the Takotna River weir should continue to include detailed figures depicting trends in age, sex, and length composition. Inclusion of detailed figures such as these allows other researchers and fishery managers to easily compare ASL trends between projects and across years. Future project reports for the Takotna River weir should continue to include historical perspectives such as the following:
    - Brood Tables and three dimensional graphics that illustrate the number of fish by age class for the recent past,
    - Inter-seasonal differences in sex composition as determined from weighted ASL samples and visual crew counts (both percent and total number),
    - Inter-seasonal trends in the number and percent of females in the escapement, and
    - Inter-seasonal trends in average length-at-age and sex.
- Continue to examine the variability between the sex ratios determined through ASL sampling and visual weir crew estimates derived during regular counts. It may be valuable to design a method to test the accuracy of visual speciation and sex determination by field crews. If a level of error could be determined for visual differentiation, counts and sex ratios could be better compared to ASL data. This, along with documentation of observed salmon behavior with emphasis on patterns of migration through the weir, could lend insight into the discrepancies between ASL and visually-derived sex ratios.

WEATHER AND STREAM OBSERVATIONS

- Investigators should install a water temperature data logger in the river channel in order to accurately determine high, low, and mean daily measurements, which would provide more complete temperature documentation and enable more reliable comparisons among years.
- Investigators should consider installing a stream gauging station in the Takotna River near the weir site or the community of Takotna similar to that installed in the George River in 2006 (Hildebrand et al. 2007). Stream gauging stations provide critical baseline data about river flow that could be used to establish a water reservation on the Takotna River. ADF&G is charged with the responsibility to "…manage, protect, maintain, improve, and extend the fish, game, and aquatic plant resources of the state in the interest of the economy and general

well-being of the state” (AS 16.05.020). Toward this end, Alaskan State law (AS 16.05.050) allows ADF&G to acquire water rights based on data and analysis that substantiates the need for the amount of water being requested (Estes 1996). A water reservation is a legal right (or appropriation of water) to maintain a specific flow rate or level in a given body of water for one or a combination of purposes: 1) protection of fish and wildlife habitat, migration, and propagation; 2) recreation and parks purposes; 3) navigation and transportation purposes; and 4) sanitary and water quality purposes (Estes 1996).

- Conduct additional stream discharge surveys to reestablish a link between river flow and stage and to calibrate the stream gauging station recommended above.

Juvenile Salmon Investigations

- Continue to survey for juvenile salmon in the upper Takotna River basin on an opportunistic basis as long as such sampling does not incur additional expenses to the project that were not provided for in the budget.
- Currently the primary objective of the juvenile salmon investigations is to document geographic distribution. If incorporation of additional objectives is desired, such as documenting relative abundance or condition factor, then a more rigorous sampling design will be required that standardizes variables such as sampling location, timing, and methodology.

Spawner-Recruit Analysis

- Continue to develop a spawner-recruit analysis for Takotna River salmon. One of the caveats in undertaking this initiative in the past was accounting for the unknown fraction of Takotna River fish harvested in the commercial and subsistence fisheries. Preliminary findings from the mark–recapture projects operated in 2002, 2003, and 2004 provide insight into the timing of Takotna River salmon stocks in the lower Kuskokwim River, which may allow for some Takotna assumptions of the temporal fraction of the harvest likely to contain fish bound for the Takotna River. Isolating harvest during that time period and applying an estimated spawning stock apportionment to account for Takotna River fish may provide the resolution required for identifying a reasonable spawner-recruit relationship.

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TABLES AND FIGURES

Table 1.–Actual daily and estimated counts of Chinook, chum, and coho salmon at the Takotna River weir, 2006.

	Chinook					Chum					Coho				
Date	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage
6/16[a]	0[b]	0[b]	0[b]			0[b]	0[b]	0[b]			0[b]	0[b]	0[b]		
6/17[a]	0	0	0			0	0	0			0	0	0		
6/18[a]	0	0	0			1	0	1			0	0	0		
6/19[a]	0	0	0			0	0	0			0	0	0		
6/20[a]	0	1	1			0	2	2			0	0	0		
6/21[a]	0	0	0			1	0	1			0	0	0		
6/22[a]	0	0	0			5	0	5			0	0	0		
6/23[a]	0	0	0			3	3	6			0	0	0		
6/24	0	0	0	0	0	12	8	20	20	0	0	0	0	0	0
6/25	1	0	1	1	0	12	9	21	41	0	0	0	0	0	0
6/26	0	0	0	1	0	16	16	32	73	1	0	0	0	0	0
6/27	0	0	0	1	0	45	20	65	138	1	0	0	0	0	0
6/28	0	0	0	1	0	47	23	70	208	2	0	0	0	0	0
6/29	2	0	2	3	1	60	34	94	302	2	0	0	0	0	0
6/30	0	0	0	3	1	102	55	157	459	4	0	0	0	0	0
7/01	3	0	3	6	1	98	77	175	634	5	0	0	0	0	0
7/02	2	1	3	9	2	106	75	181	815	6	0	0	0	0	0
7/03	0	0	0	9	2	182	124	306	1,121	9	0	0	0	0	0
7/04	10	2	12	21	4	171	138	309	1,430	11	0	0	0	0	0
7/05	11	0	11	32	6	184	167	351	1,781	14	0	0	0	0	0
7/06	10	2	12	44	8	311	282	593	2,374	19	0	0	0	0	0
7/07	16	1	17	61	11	315	301	616	2,990	24	0	0	0	0	0
7/08	23	1	24	85	16	257	202	459	3,449	27	0	0	0	0	0
7/09	43	8	51	136	25	251	229	480	3,929	31	0	0	0	0	0
7/10	29	3	32	168	31	239	223	462	4,391	35	0	0	0	0	0
7/11	14	7	21	189	35	242	227	469	4,860	39	0	0	0	0	0
7/12	17	3	20	209	39	254	234	488	5,348	42	0	0	0	0	0
7/13	14	1	15	224	42	227	221	448	5,796	46	0	0	0	0	0
7/14	12	5	17	241	45	245	272	517	6,313	50	0	0	0	0	0
7/15	0	0	0	241	45	203	210	413	6,726	53	0	0	0	0	0
7/16	3	0	3	244	45	207	185	392	7,118	57	0	0	0	0	0
7/17	19	0	19	263	49	188	204	392	7,510	60	0	0	0	0	0
7/18	13	0	13	276	51	189	204	393	7,903	63	0	0	0	0	0
7/19	36	5	41	317	59	204	239	443	8,346	66	0	0	0	0	0
7/20	42	19	61	378	70	175	180	355	8,701	69	0	0	0	0	0
7/21	30	12	42	420	78	191	250	441	9,142	73	0	0	0	0	0

-continued-

Table 1.–Page 2 of 3.

	Chinook					Chum					Coho				
Date	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage
7/22	7	5	12	432	80	140	181	321	9,463	75	0	0	0	0	0
7/23	7	5	12	444	82	121	167	288	9,751	77	0	0	0	0	0
7/24	2	2	4	448	83	125	193	318	10,069	80	0	0	0	0	0
7/25	1	2	3	451	84	112	156	268	10,337	82	0	0	0	0	0
7/26	4	2	6	457	85	100	154	254	10,591	84	0	0	0	0	0
7/27	5	4	9	466	86	101	147	248	10,839	86	0	0	0	0	0
7/28	3	1	4	470	87	92	124	216	11,055	88	0	0	0	0	0
7/29	3	1	4	474	88	51	82	133	11,188	89	0	0	0	0	0
7/30	5	3	8	482	89	60	103	163	11,351	90	1	0	1	1	0
7/31	5	2	7	489	91	63	93	156	11,507	91	1	0	1	2	0
8/01	1	0	1	490	91	54	81	135	11,642	92	0	1	1	3	0
8/02	7	4	11	501	93	53	78	131	11,773	93	1	1	2	5	0
8/03	9	2	11	512	95	64	84	148	11,921	95	7	1	8	13	0
8/04	4	1	5	517	96	54	77	131	12,052	96	9	6	15	28	1
8/05	1	2	3	520	96	16	48	64	12,116	96	5	3	8	36	1
8/06	0	0	0	520	96	31	31	62	12,178	97	3	5	8	44	1
8/07	3	1	4	524	97	19	35	54	12,232	97	8	8	16	60	1
8/08	0	0	0	524	97	20	48	68	12,300	98	9	6	15	75	1
8/09	1	0	1	525	97	9	20	29	12,329	98	11	14	25	100	2
8/10	1	0	1	526	98	9	16	25	12,354	98	5	2	7	107	2
8/11	1	1	2	528	98	9	19	28	12,382	98	75	37	112	219	4
8/12	0	0	0	528	98	9	7	16	12,398	98	24	16	40	259	5
8/13	0	0	0	528	98	8	13	21	12,419	99	35	18	53	312	6
8/14	1	0	1	529	98	16	18	34	12,453	99	19	12	31	343	6
8/15	2	2	4	533	99	7	12	19	12,472	99	50	24	74	417	8
8/16	0	0	0	533	99	8	14	22	12,494	99	81	37	118	535	10
8/17	1	0	1	534	99	11	5	16	12,510	99	116	59	175	710	13
8/18	0	0	0	534	99	6	4	10	12,520	99	80	41	121	831	15
8/19	--[c]	--[c]	1[d]	535	99	--[c]	--[c]	12[d]	12,532	99	--[c]	--[c]	159[d]	990	18
8/20	--[c]	--[c]	1[d]	535	99	--[c]	--[c]	10[d]	12,542	100	--[c]	--[c]	170[d]	1,161	21
8/21	--[c]	--[c]	1[d]	536	99	--[c]	--[c]	9[d]	12,550	100	--[c]	--[c]	182[d]	1,342	24
8/22	0[e]	0[e]	1[f]	536	99	4[e]	1[e]	7[f]	12,557	100	26[e]	13[e]	193[f]	1,535	28
8/23	1	0	1	537	100	0	3	3	12,560	100	79	46	125	1,660	30
8/24	0	0	0	537	100	3	5	8	12,568	100	170	113	283	1,943	35
8/25	0	0	0	537	100	1	1	2	12,570	100	162	128	290	2,233	40
8/26	1	0	1	538	100	0	4	4	12,574	100	51	60	111	2,344	42
8/27	0	0	0	538	100	1	3	4	12,578	100	134	98	232	2,576	46

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Table 1.–Page 3 of 3.

	Chinook					Chum					Coho				
Date	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage	Male	Female	Daily Totals	Cum.	Cum. % Passage
8/28	0	0	0	538	100	2	3	5	12,583	100	113	118	231	2,807	51
8/29	0	0	0	538	100	3	1	4	12,587	100	77	61	138	2,945	53
8/30	0	0	0	538	100	2	2	4	12,591	100	119	116	235	3,180	57
8/31	1	0	1	539	100	1	1	2	12,593	100	59	56	115	3,295	59
9/01	0	0	0	539	100	0	0	0	12,593	100	142	89	231	3,526	64
9/02	0	0	0	539	100	0	0	0	12,593	100	91	64	155	3,681	66
9/03	0	0	0	539	100	0	0	0	12,593	100	70	56	126	3,807	69
9/04	0	0	0	539	100	2	1	3	12,596	100	40	64	104	3,911	70
9/05	0	0	0	539	100	0	0	0	12,596	100	41	33	74	3,985	72
9/06	0	0	0	539	100	0	0	0	12,596	100	109	145	254	4,239	76
9/07	0	0	0	539	100	0	0	0	12,596	100	59	73	132	4,371	79
9/08	0	0	0	539	100	0	0	0	12,596	100	163	165	328	4,699	85
9/09	0	0	0	539	100	0	0	0	12,596	100	87	77	164	4,863	88
9/10	0	0	0	539	100	0	0	0	12,596	100	45	60	105	4,968	90
9/11	0	0	0	539	100	1	0	1	12,597	100	52	67	119	5,087	92
9/12	0	0	0	539	100	0	0	0	12,597	100	33	33	66	5,153	93
9/13	0	0	0	539	100	0	0	0	12,597	100	23	42	65	5,218	94
9/14	0	0	0	539	100	0	0	0	12,597	100	20	41	61	5,279	95
9/15	0	0	0	539	100	0	0	0	12,597	100	16	25	41	5,320	96
9/16	0	0	0	539	100	0	1	1	12,598	100	19	35	54	5,374	97
9/17	0	0	0	539	100	0	0	0	12,598	100	18	30	48	5,422	98
9/18	0	0	0	539	100	0	0	0	12,598	100	20	22	42	5,464	98
9/19	0	0	0	539	100	0	0	0	12,598	100	15	28	43	5,507	99
9/20	0	0	0	539	100	0	0	0	12,598	100	17	24	41	5,548	100
9/21[a]	0	0	0			0	0	0			22	18	40		
9/22[a]	0	0	0			0	0	0			28	31	59		
Total Escapement[g]	427	110	539			6,121	6,445	12,598			2,610	2,273	5,548		
Observed Escapement			537					12,566					4,883		
Percent Estimated			0.4%					0.3%					12.0%		

Note: Discrepancies between the sum of the daily totals and the cumulative passage are attributed to rounding errors.

[a] Daily passage for this date is not included in cumulative escapement; the date is outside of the target operational period.

[b] Partial day count; passage was not estimated.

[c] Daily estimates were not partitioned by sex.

[d] The weir was not operational; daily passage was estimated.

[e] Partial day count. Total daily passage was estimated but not partitioned by sex.

[f] Partial day count. Passage was estimated.

[g] "Total escapement" does not include passage on days outside of the target operational period.

Table 2.–Age and sex composition of Chinook salmon sampled at the Takotna River weir in 2006 using escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 1.1 Esc.	1.1 %	1.2 Esc.	1.2 %	1.3 Esc.	1.3 %	2.2 Esc.	2.2 %	1.4 Esc.	1.4 %	1.5 Esc.	1.5 %	2.4 Esc.	2.4 %	Total Esc.	Total %
6/29-7/14	106	M	9	3.8	109	45.3	68	28.3	0	0.0	13	5.7	0	0.0	0	0.0	200	83.0
(6/24-7/15)		F	0	0.0	0	0.0	5	1.9	0	0.0	32	13.2	5	1.9	0	0.0	41	17.0
		Subtotal[a]	9	3.8	109	45.3	73	30.2	0	0.0	45	18.9	5	1.9	0	0.0	241	100.0
7/17-20	80	M	0	0.0	80	58.8	31	22.5	0	0.0	5	3.8	0	0.0	0	0.0	116	85.0
(7/16-20)		F	0	0.0	0	0.0	5	3.8	0	0.0	14	10.0	2	1.3	0	0.0	21	15.0
		Subtotal[a]	0	0.0	80	58.8	36	26.3	0	0.0	19	13.8	2	1.3	0	0.0	137	100.0
7/21-8/7	83	M	0	0.0	39	24.1	37	22.9	0	0.0	19	12.0	2	1.2	0	0.0	97	60.2
(7/21-9/20)		F	0	0.0	0	0.0	17	10.8	0	0.0	41	25.3	6	3.6	0	0.0	64	39.8
		Subtotal[a]	0	0.0	39	24.1	54	33.7	0	0.0	60	37.3	8	4.8	0	0.0	161	100.0
Season[b]	269	M	9	1.7	228	42.4	136	25.2	0	0.0	38	7.1	2	0.4	0	0.0	414	76.7
		F	0	0.0	0	0.0	27	5.0	0	0.0	86	16.0	12	2.2	0	0.0	125	23.3
		Total	9	1.7	228	42.4	163	30.2	0	0.0	124	23.1	14	2.6	0	0.0	539	100.0

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 3.–Mean length (mm) of Chinook salmon sampled at the Takotna River weir in 2006 using escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	1.2	1.3	2.2	1.4	1.5	2.4
6/29-7/14	M	Mean Length	389	567	683		801		
(6/24-7/15)		SE	10	6	11		27		
		Range	362- 412	454- 658	546- 815		720- 920		
		Sample Size	4	48	30	0	6	0	0
	F	Mean Length			816		860	829	
		SE			1		19	19	
		Range			815- 816		755-1012	810- 848	
		Sample Size	0	0	2	0	14	2	0
7/17-20	M	Mean Length		553	685		821		
(7/16-20)		SE		6	15		52		
		Range		420- 608	580- 830		756- 924		
		Sample Size	0	47	18	0	3	0	0
	F	Mean Length			750		868	812	
		SE			29		19	-	
		Range			705- 804		785- 976	812- 812	
		Sample Size	0	0	3	0	8	1	0
7/21-8/7	M	Mean Length		560	695		745	813	
(7/21-9/20)		SE		10	12		23	-	
		Range		448- 643	595- 785		642- 858	813- 813	
		Sample Size	0	20	19	0	10	1	0
	F	Mean Length			759		843	871	
		SE			30		10	15	
		Range			607- 893		740- 907	843- 896	
		Sample Size	0	0	9	0	21	3	0
Season[a]	M	Mean Length	389	561	687		775	813	
		Range	362- 412	420- 658	546- 830		642- 924	813- 813	
		Sample Size	4	115	67	0	19	1	0
	F	Mean Length			767		853	847	
		Range			607- 893		740-1012	810- 896	
		Sample Size	0	0	14	0	43	6	0

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 2.

[a] "Season" mean lengths are weighted by the escapement passage in each stratum.

Table 4.–Age and sex composition of chum salmon at the Takotna River weir in 2006 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 0.2 Esc.	0.2 %	0.3 Esc.	0.3 %	0.4 Esc.	0.4 %	0.5 Esc.	0.5 %	Total Esc.	Total %
6/28-30	194	M	0	0.0	134	16.5	395	48.4	8	1.0	538	66.0
(6/28-7/2)		F	0	0.0	118	14.4	160	19.6	0	0.0	277	34.0
		Subtotal[a]	0	0.0	252	30.9	555	68.0	8	1.0	815	100.0
7/5-7	199	M	0	0.0	1,260	31.2	1,199	29.6	0	0.0	2,460	60.8
(7/3-11)		F	0	0.0	935	23.1	651	16.1	0	0.0	1,585	39.2
		Subtotal[a]	0	0.0	2,195	54.3	1,850	45.7	0	0.0	4,045	100.0
7/15-17	186	M	19	0.5	1,237	35.5	694	19.9	0	0.0	1,949	55.9
(7/12-19)		F	93	2.7	1,162	33.3	281	8.1	0	0.0	1,537	44.1
		Subtotal[a]	112	3.2	2,399	68.8	975	28.0	0	0.0	3,486	100.0
7/21-23	197	M	34	1.5	695	30.9	285	12.7	0	0.0	1,014	45.2
(7/20-26)		F	34	1.5	866	38.6	330	14.7	0	0.0	1,231	54.8
		Subtotal[a]	68	3.0	1,561	69.5	615	27.4	0	0.0	2,245	100.0
7/29-31	198	M	12	1.0	299	25.2	137	11.6	0	0.0	448	37.9
(7/27-8/2)		F	24	2.0	543	46.0	167	14.2	0	0.0	734	62.1
		Subtotal[a]	36	3.0	842	71.2	304	25.8	0	0.0	1,182	100.0
8/5-8	195	M	8	1.0	203	24.6	68	8.2	0	0.0	279	33.8
(8/3-9/20)		F	51	6.2	385	46.7	110	13.3	0	0.0	546	66.2
		Subtotal[a]	59	7.2	588	71.3	178	21.5	0	0.0	825	100.0
Season[b]	1,169	M	73	0.6	3,828	30.4	2,777	22.0	8	0.1	6,688	53.1
		F	203	1.6	4,009	31.8	1,699	13.5	0	0.0	5,910	46.9
		Total	276	2.2	7,837	62.2	4,476	35.5	8	0.1	12,598	100.0

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 5.–Mean length (mm) of chum salmon at the Takotna River weir in 2006 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
6/28-30	M	Mean Length		567	580	649
(6/28-7/2)		SE		5	3	7
		Range		511- 635	508- 664	642- 655
		Sample Size	0	32	94	2
	F	Mean Length		540	558	
		SE		4	4	
		Range		503- 578	506- 627	
		Sample Size	0	28	38	0
7/5-7	M	Mean Length		558	574	
(7/3-11)		SE		3	4	
		Range		511- 606	505- 658	
		Sample Size	0	62	59	0
	F	Mean Length		539	552	
		SE		3	5	
		Range		502- 596	473- 606	
		Sample Size	0	46	32	0
7/15-17	M	Mean Length	509	560	583	
(7/12-19)		SE	-	3	5	
		Range	509- 509	482- 615	532- 661	
		Sample Size	1	66	37	0
	F	Mean Length	511	550	564	
		SE	8	3	9	
		Range	483- 526	491- 590	504- 648	
		Sample Size	5	62	15	0
7/21-23	M	Mean Length	521	567	575	
(7/20-26)		SE	2	4	5	
		Range	517- 523	495- 632	521- 640	
		Sample Size	3	61	25	0
	F	Mean Length	521	538	551	
		SE	14	3	4	
		Range	502- 549	456- 599	502- 598	
		Sample Size	3	76	29	0
7/29-31	M	Mean Length	549	557	577	
(7/27-8/2)		SE	23	5	8	
		Range	526- 572	498- 636	505- 666	
		Sample Size	2	50	23	0
	F	Mean Length	512	532	536	
		SE	6	3	5	
		Range	496- 527	471- 624	481- 588	
		Sample Size	4	91	28	0

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Table 5.–Page 2 of 2.

Sample Dates (Stratum Dates)	Sex		Age Class 0.2	0.3	0.4	0.5
8/5-8	M	Mean Length	543	547	562	
(8/3-9/20)		SE	16	5	7	
		Range	527- 558	435- 621	504- 613	
		Sample Size	2	48	16	0
	F	Mean Length	494	528	532	
		SE	8	3	7	
		Range	450- 548	448- 587	471- 615	
		Sample Size	12	91	26	0
Season[a]	M	Mean Length	525	560	577	649
		Range	509- 572	435- 636	504- 666	642- 655
		Sample Size	8	319	254	2
	F	Mean Length	509	540	552	
		Range	450- 549	448- 624	471- 648	
		Sample Size	24	394	168	0

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 4.

[a] "Season" mean lengths are weighted by the escapement passage in each stratum.

Table 6.–Age and sex composition of coho salmon at the Takotna River weir in 2006 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sample Size	Sex	Age Class 1.1 Esc.	1.1 %	2.1 Esc.	2.1 %	3.1 Esc.	3.1 %	Total Esc.	Total %
8/14-16	154	M	38	3.3	709	61.1	30	2.6	777	66.9
(6/24-8/20)		F	37	3.2	339	29.2	8	0.6	384	33.1
		Subtotal[a]	75	6.5	1,048	90.3	38	3.2	1,161	100.0
8/26-28	138	M	29	1.4	980	48.6	58	2.9	1,068	52.9
(8/21-30)		F	0	0.0	907	44.9	44	2.2	951	47.1
		Subtotal[a]	29	1.4	1,887	93.5	102	5.1	2,019	100.0
9/2-4	143	M	50	2.1	1,143	48.2	17	0.7	1,209	51.0
(8/31-9/20)		F	33	1.4	1,093	46.2	33	1.4	1,159	49.0
		Subtotal[a]	83	3.5	2,236	94.4	50	2.1	2,368	100.0
Season[b]	435	M	116	2.1	2,832	51.0	105	1.9	3,053	55.0
		F	71	1.3	2,339	42.2	85	1.5	2,495	45.0
		Total	187	3.4	5,171	93.2	190	3.4	5,548	100.0

[a] The number of fish in each stratum age and sex category are derived from the sample percentages; discrepancies in sums are attributed to rounding errors.

[b] The number of fish in "Season" summaries are the strata sums; "Season" percentages are derived from the sums of the estimated escapement that occurred in each stratum.

Table 7.–Mean length (mm) of coho salmon at the Takotna River weir in 2006 based on escapement samples collected with a live trap.

Sample Dates (Stratum Dates)	Sex		Age Class 1.1	2.1	3.1
8/14-16 (6/24-8/20)	M	Mean Length	511	518	502
		SE	20	4	30
		Range	459- 570	388- 601	428- 558
		Sample Size	5	94	4
	F	Mean Length	518	521	527
		SE	12	5	-
		Range	484- 552	405- 565	527- 527
		Sample Size	5	45	1
8/26-28 (8/21-30)	M	Mean Length	534	511	533
		SE	26	4	19
		Range	508- 560	425- 582	494- 585
		Sample Size	2	67	4
	F	Mean Length		519	521
		SE		4	13
		Range		365- 576	497- 542
		Sample Size	0	62	3
9/2-4 (8/31-9/20)	M	Mean Length	534	524	526
		SE	42	5	-
		Range	450- 579	418- 592	526- 526
		Sample Size	3	69	1
	F	Mean Length	546	517	522
		SE	6	5	10
		Range	540- 552	414- 659	512- 532
		Sample Size	2	66	2
Season[a]	M	Mean Length	526	518	523
		Range	450- 579	388- 601	428- 585
		Sample Size	10	230	9
	F	Mean Length	531	518	522
		Range	484- 552	365- 659	497- 542
		Sample Size	7	173	6

Note: The sum of the sample sizes in each stratum equal the total sample size reported for that stratum in Table 6.

[a] "Season" mean lengths are weighted by the escapement passage in each stratum.

Table 8.–Historical number caught and CPUE for juvenile Chinook salmon caught using minnow traps.

Index	Number Caught							CPUE[b]						
Area[a]	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
1	0	0	ND	ND	1	15	ND	0.00	0.00	ND	ND	0.04	0.03	ND
2	15	0	4	3	0	ND	ND	0.01	0.00	0.01	0.01	0.00	ND	ND
3	58	17	29	0	7	0	ND	0.07	0.04	0.02	0.00	0.02	0.00	ND
4	26	98	132	50	24	ND	ND	0.07	0.09	0.13	0.21	0.06	ND	ND
5	0	ND	4	ND	0	0	0	0.00	ND	0.01	ND	0.00	0.00	0.00
6	0	0	ND	ND	0	ND	ND	0.00	0.00	ND	ND	0.00	ND	ND
7	ND	0	ND	ND	ND	1	0	ND	0.00	ND	ND	ND	0.00	0.00
8	ND	ND	0	ND	ND	0	ND	ND	ND	0.00	ND	ND	0.00	ND
9	ND	0	ND	ND	2	ND	ND	ND	0.00	ND	ND	0.00	ND	ND
10	ND	0	ND	ND	0	ND	0	ND	0.00	ND	ND	0.00	ND	0.00
11	ND	ND	ND	0	0	8	0	ND	ND	ND	0.00	0.00	0.01	0.00
12	ND	0	ND	ND	ND	0	ND	ND	0.00	ND	ND	ND	0.00	ND
13	ND	0	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND
14[c]	ND	ND	ND	ND	230	397	ND	ND	ND	ND	ND	0.51	0.63	ND
Totals:	99	115	169	53	264	421	0	0.03	0.03	0.04	0.05	0.01[d]	0.01[d]	0.00

Note: ND means "no data."

[a] See Figure 4 for description of Index Areas.

[b] CPUE is defined as the number of salmon captured per trap-hour.

[c] Added as an Index Area in 2004.

[d] To allow comparisons among years, total CPUE does not include Gold Creek.

Table 9.–Historical number caught and CPUE for juvenile coho salmon caught using minnow traps.

Index	Number Caught							CPUE[b]						
Area[a]	2000	2001	2002	2003	2004	2005	2006	2000	2001	2002	2003	2004	2005	2006
1	0	0	ND	ND	7	3	ND	0.00	0.00	ND	ND	0.28	0.01	ND
2	0	0	21	2	0	ND	ND	0.00	0.00	0.03	0.01	0.00	ND	ND
3	10	116	26	26	246	84	ND	0.01	0.27	0.02	0.11	0.62	0.35	ND
4	3	129	23	1	16	ND	ND	0.01	0.12	0.02	0.00	0.04	ND	ND
5	0	ND	23	ND	0	0	0	0.00	ND	0.06	ND	0.00	0.00	0.00
6	0	0	ND	ND	0	ND	ND	0.00	0.00	ND	ND	0.00	ND	ND
7	ND	0	ND	ND	ND	0	0	ND	0.00	ND	ND	ND	0.00	0.00
8	ND	ND	16	ND	ND	0	ND	ND	ND	0.20	ND	ND	0.00	ND
9	ND	0	ND	ND	0	ND	ND	ND	0.00	ND	ND	0.00	ND	ND
10	ND	0	ND	ND	0	ND	0	ND	0.00	ND	ND	0.00	ND	0.00
11	ND	ND	ND	0	1	33	0	ND	ND	ND	0.00	0.01	0.04	0.00
12	ND	0	ND	ND	ND	0	ND	ND	0.00	ND	ND	ND	0.00	ND
13	ND	0	ND	ND	ND	ND	ND	ND	0.00	ND	ND	ND	ND	ND
14[c]	ND	ND	ND	ND	12	17	ND	ND	ND	ND	ND	0.03	0.03	ND
Totals:	13	245	109	29	282	137	0	0.00	0.06	0.03	0.03	0.09[d]	0.04[d]	0.00

Note: ND means "no data."

[a] See Figure 4 for description of Index Areas.

[b] CPUE is defined as the number of salmon captured per trap-hour.

[c] Added as an Index Area in 2004.

[d] To allow comparisons among years, total CPUE does not include Gold Creek.

Table 10.–Brood table for Takotna River Chinook salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year						Returns[a]	Return per Spawner[a]
		3	4	5	6	7	8		
1987	ND	ND	ND	ND	ND	ND	ND	ND	ND
1988	ND	ND	ND	ND	ND	ND	ND	ND	ND
1989	ND	ND	ND	ND	ND	ND	ND	ND	ND
1990	ND	ND	ND	ND	ND	ND	ND	ND	ND
1991	ND	ND	ND	ND	ND	ND	ND	ND	ND
1992	ND	ND	ND	ND	ND	ND	0	-	-
1993	ND	ND	ND	ND	ND	2	-	-	-
1994	ND	ND	ND	ND	123	-	0	-	-
1995	156[bc]	ND	ND	109	-	3	-	-	-
1996	422[b]	ND	106	-	145	-	-	-	-
1997	1161[b]	5	-	94	-	-	-	-	-
1998	21[bc]	-	69	-	-	-	0	-	-
1999	ND[d]	0	-	-	-	14	ND	-	-
2000	345	-	-	-	124	ND	ND	-	-
2001	721[e]	-	-	163	ND	ND	ND	-	-
2002	316	-	228	ND	ND	ND	ND	-	-
2003	378[e]	9	ND	ND	ND	ND	ND	-	-
2004	461[e]	ND	ND	ND	ND	ND	ND	ND	ND
2005	499[e]	ND	ND	ND	ND	ND	ND	ND	ND
2006	539	ND	ND	ND	ND	ND	ND	ND	ND

[a] Total returns and return per spawner can not be calculated due to insufficient data.
[b] Total escapement enumerated from tower counts. ASL sampling was not conducted.
[c] Incomplete escapement estimates.
[d] Project was not operated.
[e] ASL sampling was not adequate to determine age composition of the escapement; returns from brood year are not known.

Table 11.–Brood table for Takotna River chum salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year				Returns[a]	Return per Spawner[a]
		3	4	5	6		
1989	ND	ND	ND	ND	ND	ND	ND
1990	ND	ND	ND	ND	ND	ND	ND
1991	ND	ND	ND	ND	ND	ND	ND
1992	ND	ND	ND	ND	ND	ND	ND
1993	ND	ND	ND	ND	ND	ND	ND
1994	ND	ND	ND	ND	5	-	-
1995	1,685[bc]	ND	ND	442	11	-	-
1996	2,872[b]	ND	774	1,337	54	-	-
1997	1,779[b]	33	4,068	2,221	17	6,339	3.6
1998	45[bc]	4	1,994	370	0	2,368	-
1999	ND[d]	107	2,835	622	0	3,564	-
2000	1,254	171	775	95	8	1,049	0.8
2001	5,414	236	5,816	4,476	ND	10,528[e]	1.9[e]
2002	4,377	556	7,837	ND	ND	-	-
2003	3,393	276	ND	ND	ND	-	-
2004	1,630	ND	ND	ND	ND	ND	ND
2005	6,467	ND	ND	ND	ND	ND	ND
2006	12,598	ND	ND	ND	ND	ND	ND

[a] For most years, total returns and return per spawner could not be calculated due to insufficient data.

[b] Total escapement enumerated from tower counts. ASL sampling was not conducted.

[c] Incomplete escapement estimates. Return per spawner could not be calculated.

[d] Project was not operated. Return per spawner could not be calculated.

[e] This value does not completely represent the total return from 2001 brood year because return data for the age-6 fish will not be available until 2007. However, since age-6 fish typically comprise such a small fraction of total return, the return per spawner ratio can be reasonably calculated without this information.

Table 12.–Brood table for Takotna River coho salmon.

Brood Years	Escapement (spawners)	Number by Age in Return Year			Returns[a]	Return per Spawner[a]
		3	4	5		
1995	ND	ND	ND	80	-	-
1996	ND	ND	3,866	307	-	-
1997	ND	11	2,291	219	2,521	-
1998	ND	7	3,756	911	4,674	-
1999	ND	9	6,197	52	6,258	-
2000	3,957	62	3,146	267	3,475	0.9
2001	2,606	8	1,944	190	2,142	0.8
2002	3,984	5	5,171	ND	-	-
2003	7,171	187	ND	ND	-	-
2004	3,207	ND	ND	ND	ND	ND
2005	2,216	ND	ND	ND	ND	ND
2006	5,548	ND	ND	ND	ND	ND

[a] Total returns and return per spawner can not be calculated for most brood years due to insufficient data.

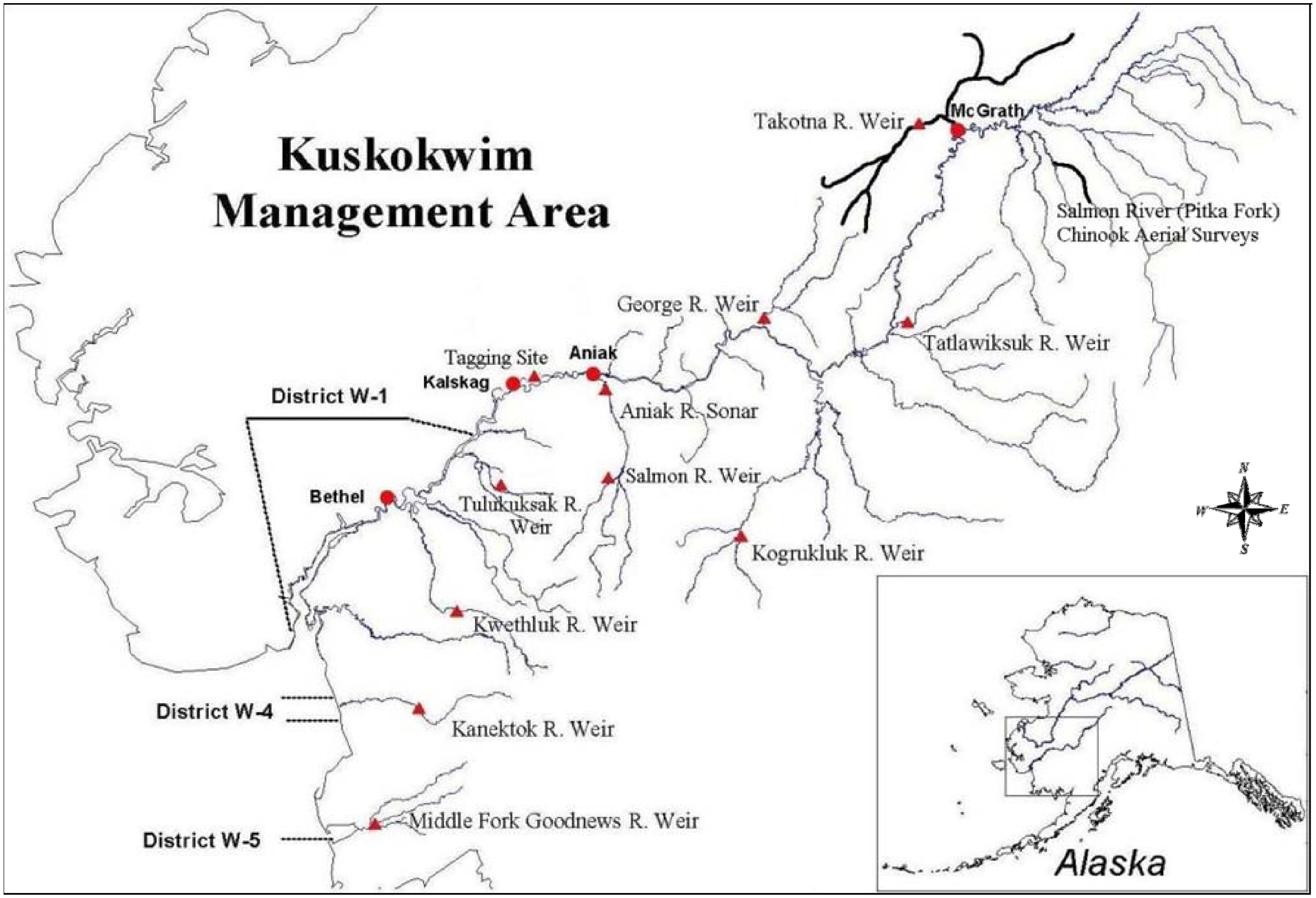


Figure 1.–Location of Kuskokwim Area salmon management districts and escapement monitoring projects with emphasis on Takotna River and Salmon River of the Pitka Fork.

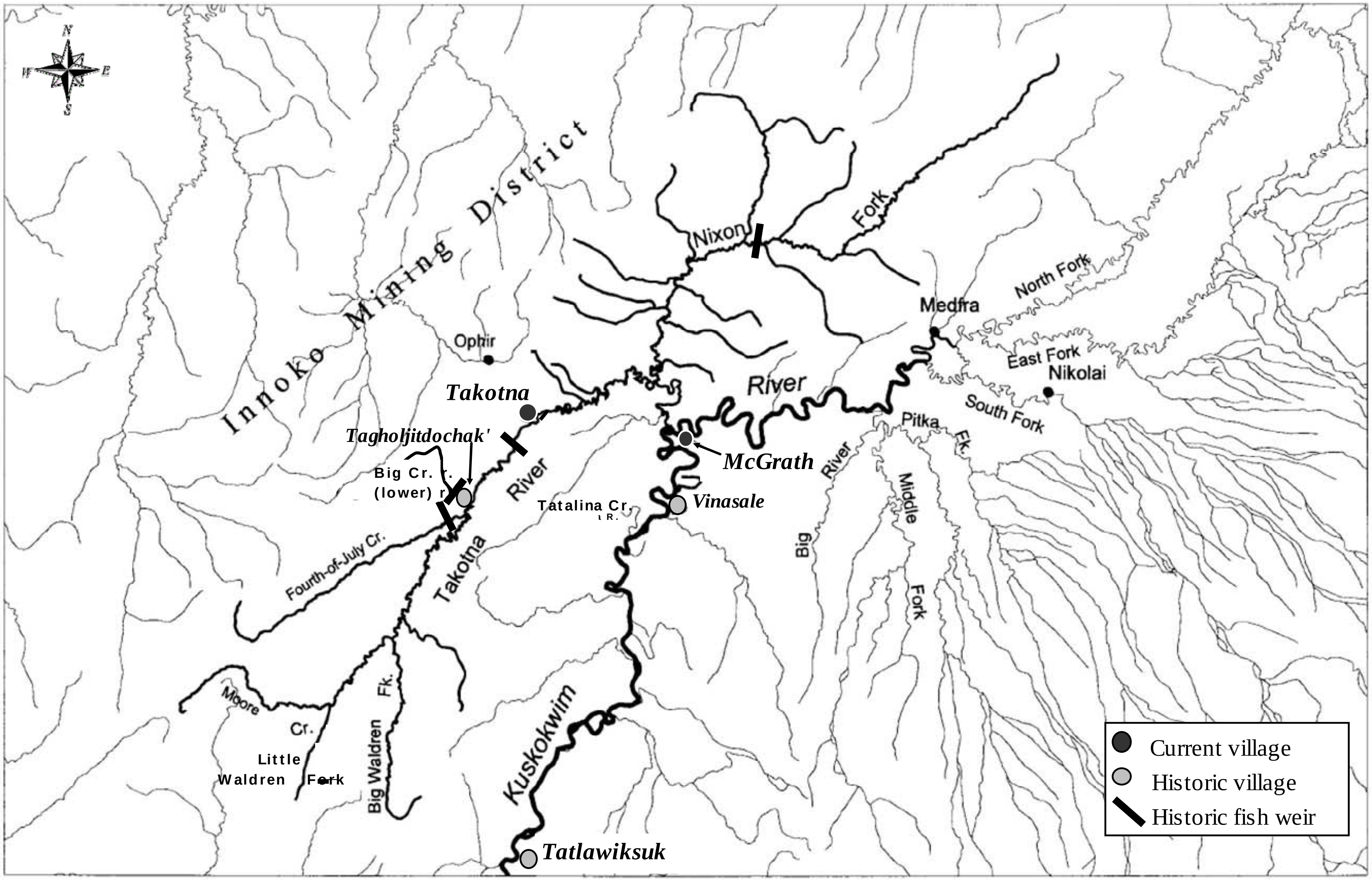


Figure 2.–Takotna River drainage and the location of historic native communities and fish weirs.

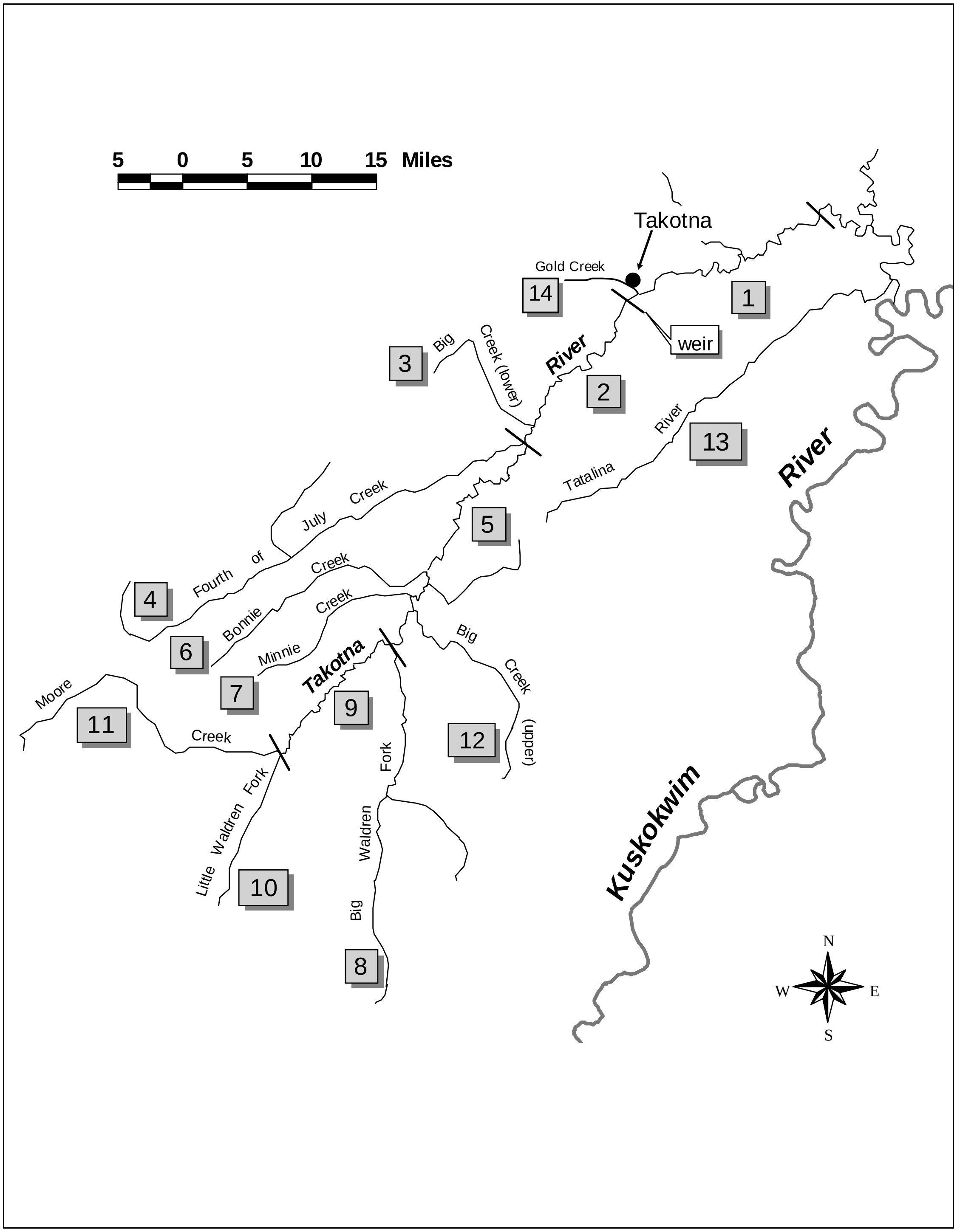


Figure 3.–Map depicting the Index Areas surveyed for juvenile salmon in the Takotna River drainage.

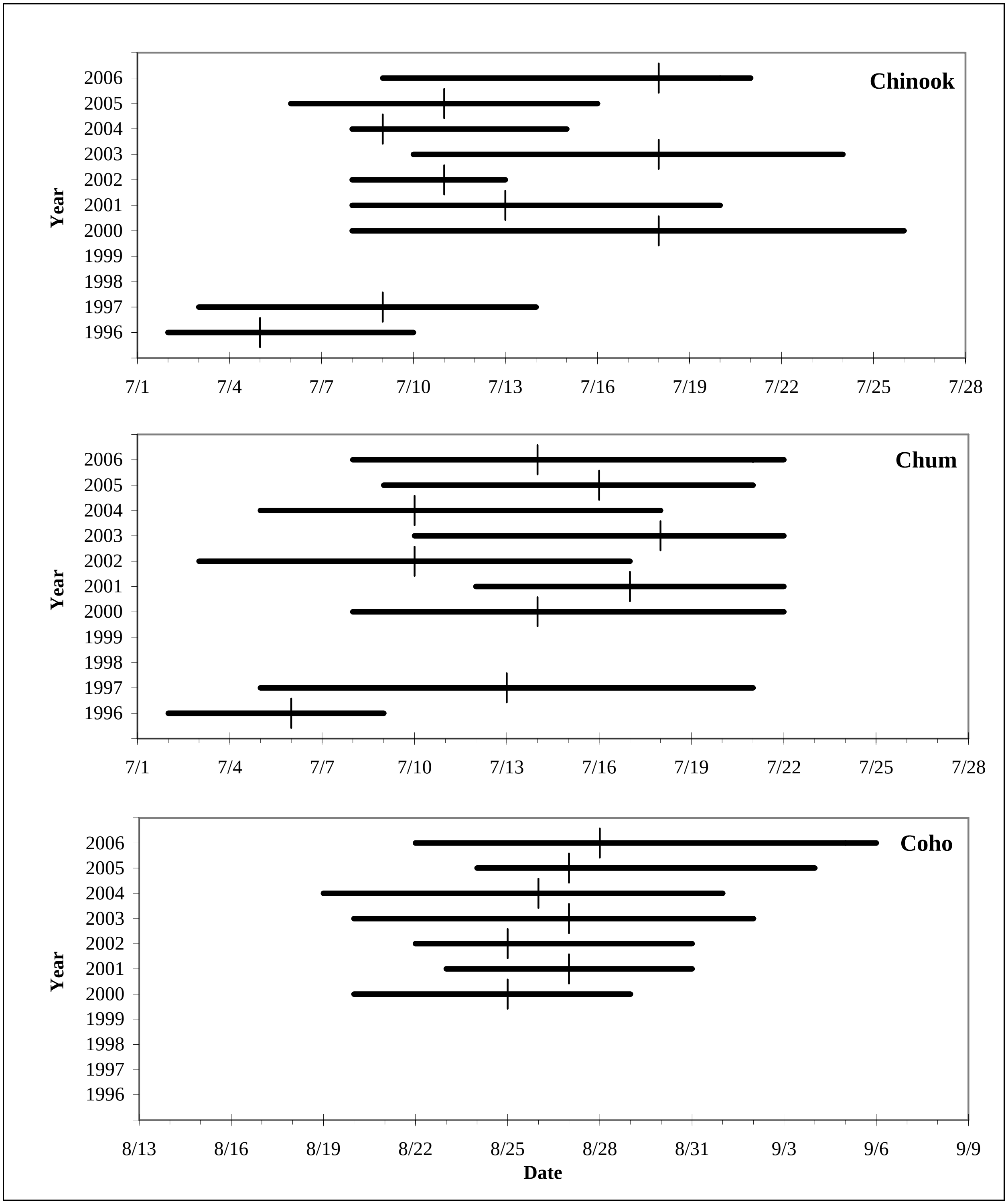


Figure 4.–Annual run timing of Chinook, chum, and coho salmon based on cumulative percent passage at the Takotna River weir, 1996–2006.

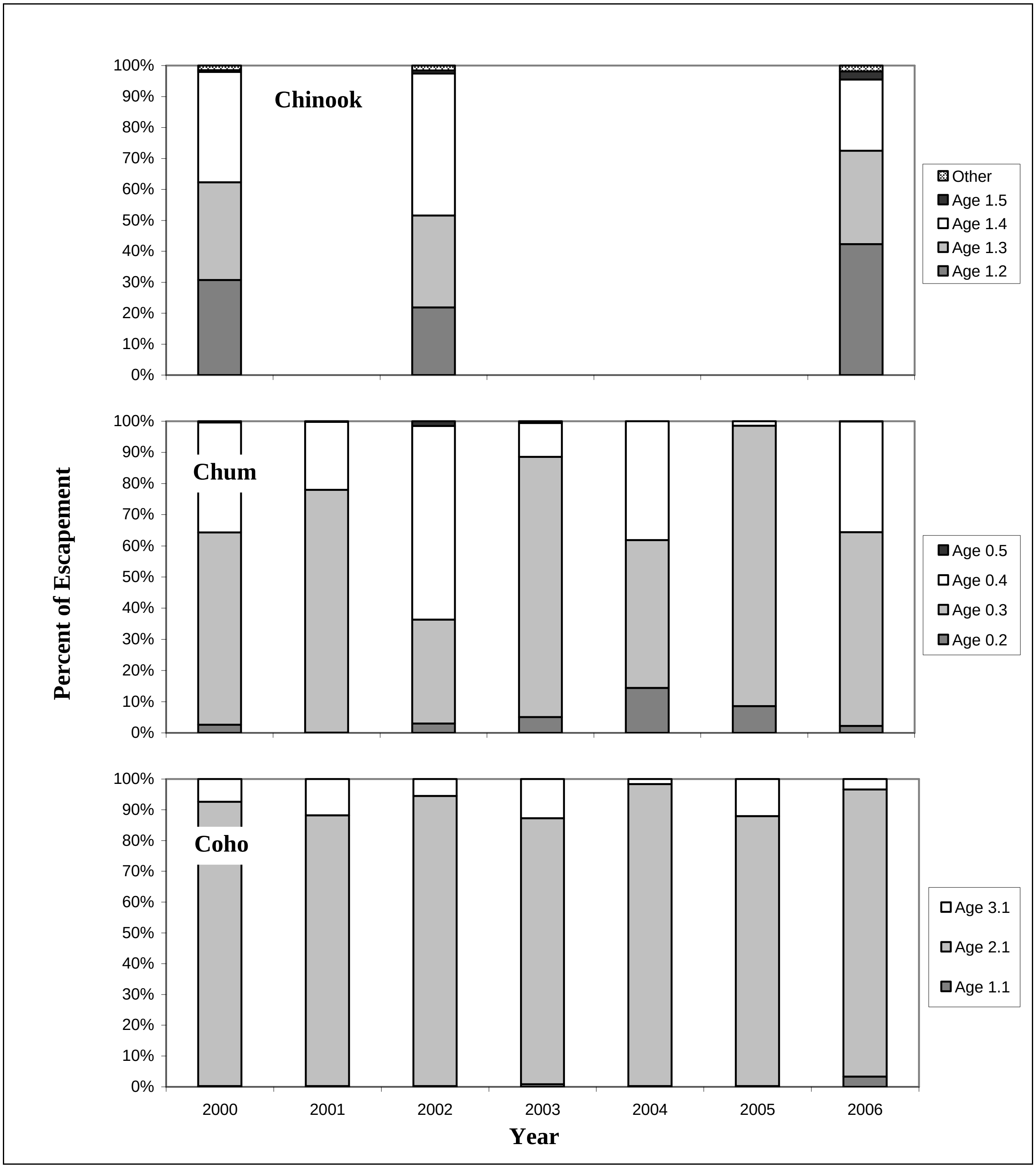


Figure 5.–Historical age composition of Chinook, chum, and coho salmon at the Takotna River weir 2000–2006.

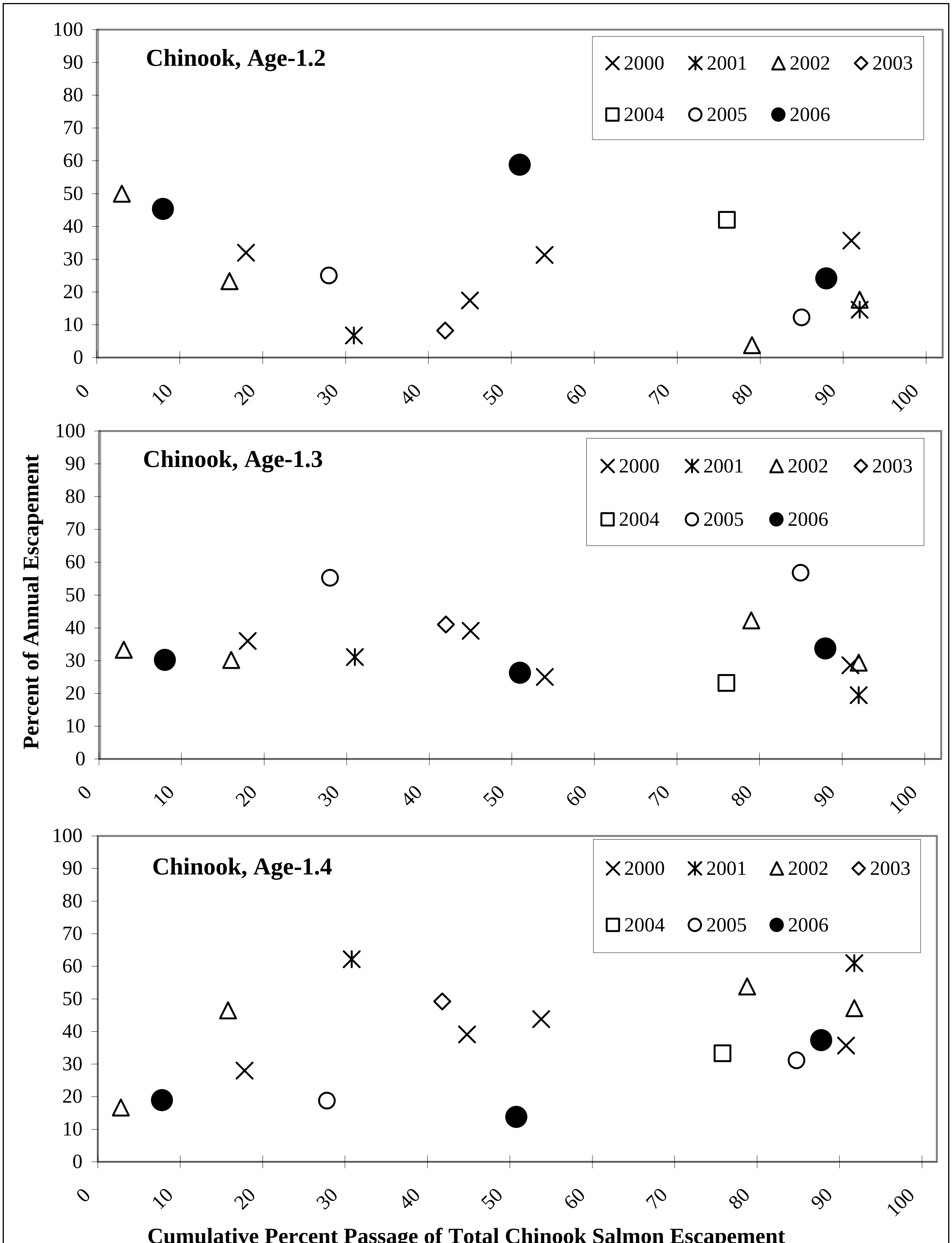


Figure 6.–Historical age composition by total cumulative percent passage for Chinook salmon at the Takotna River weir.

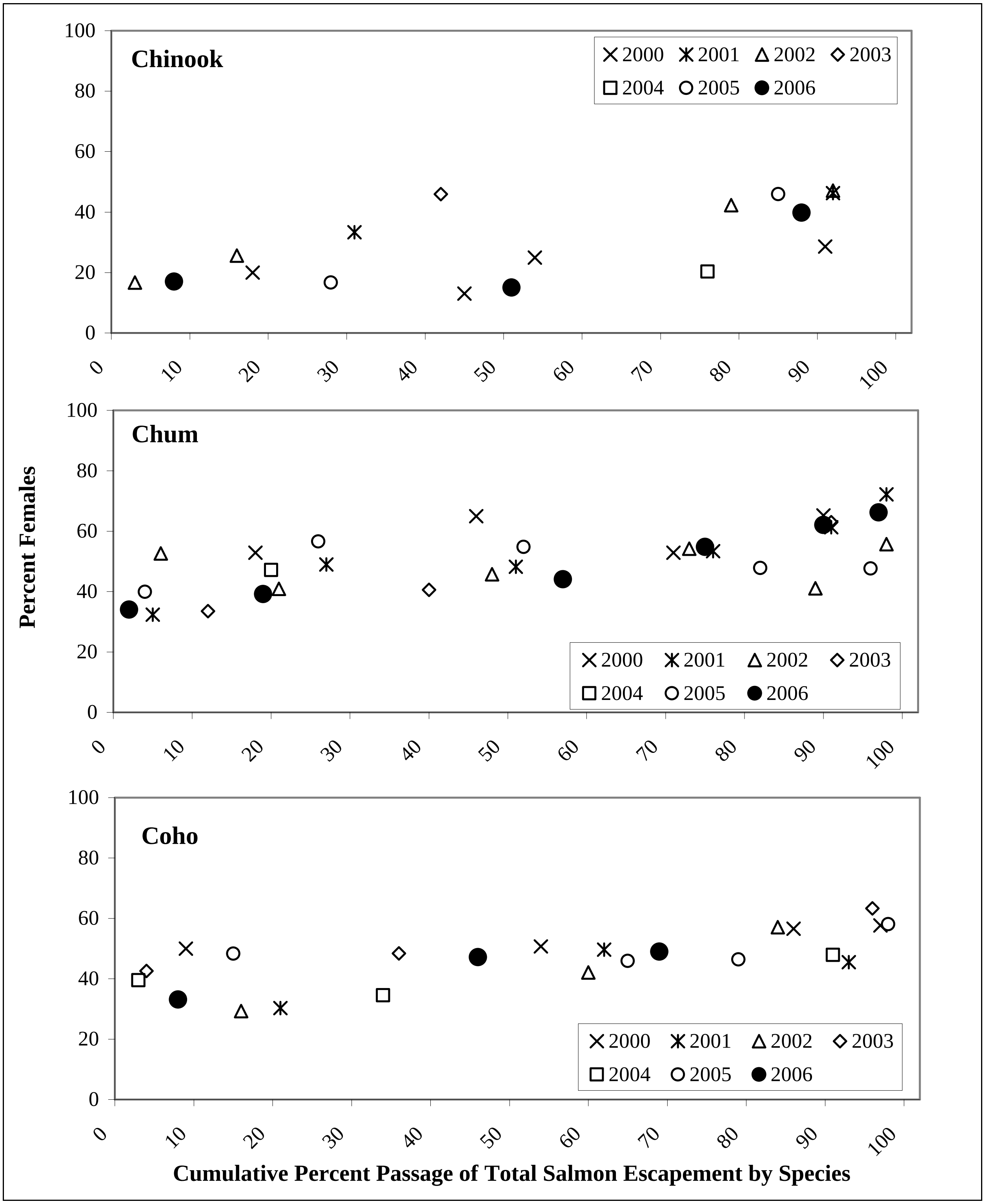


Figure 7.–Historical percentage of female Chinook, chum, and coho salmon by cumulative percent passage at the Takotna River weir.

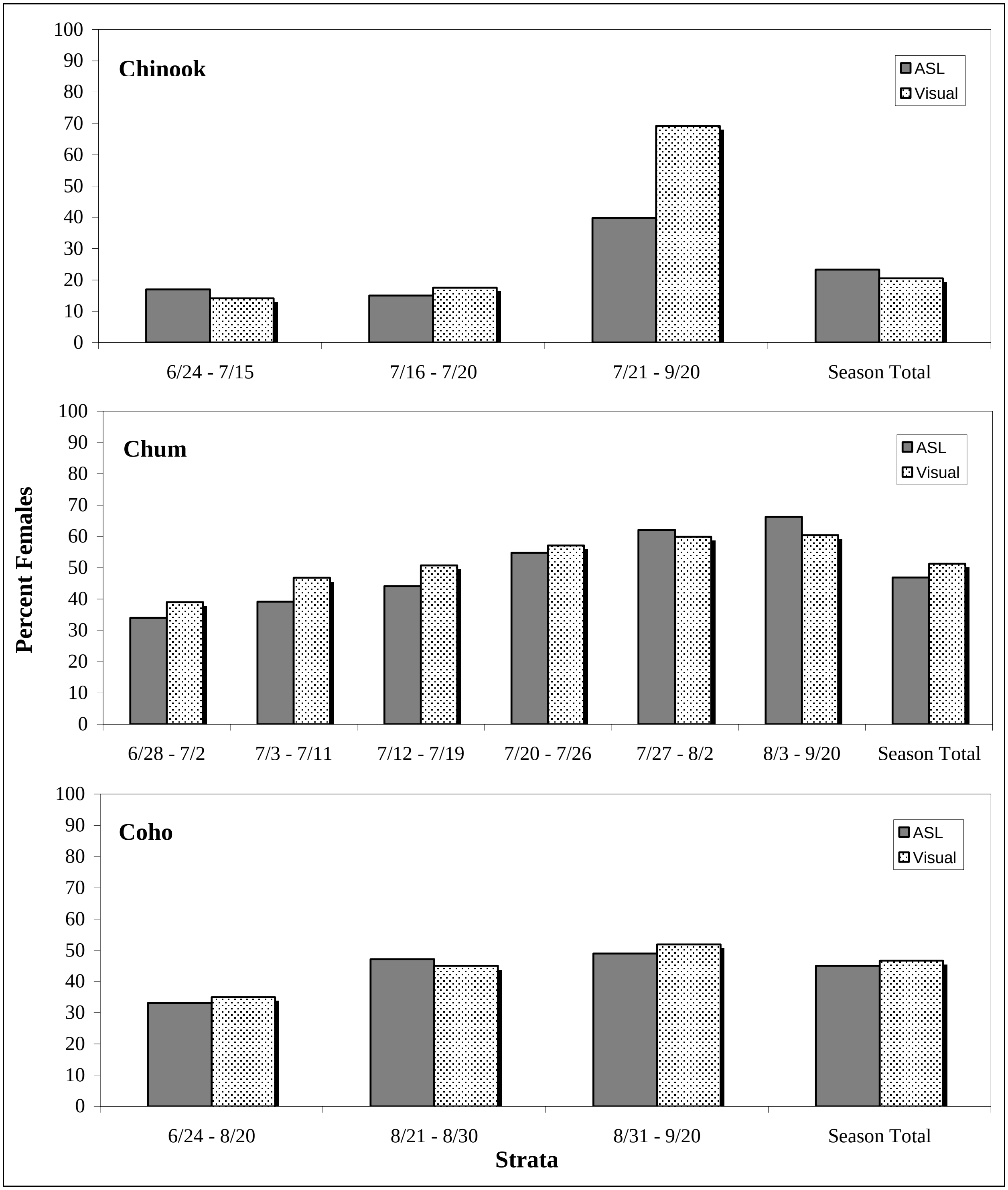
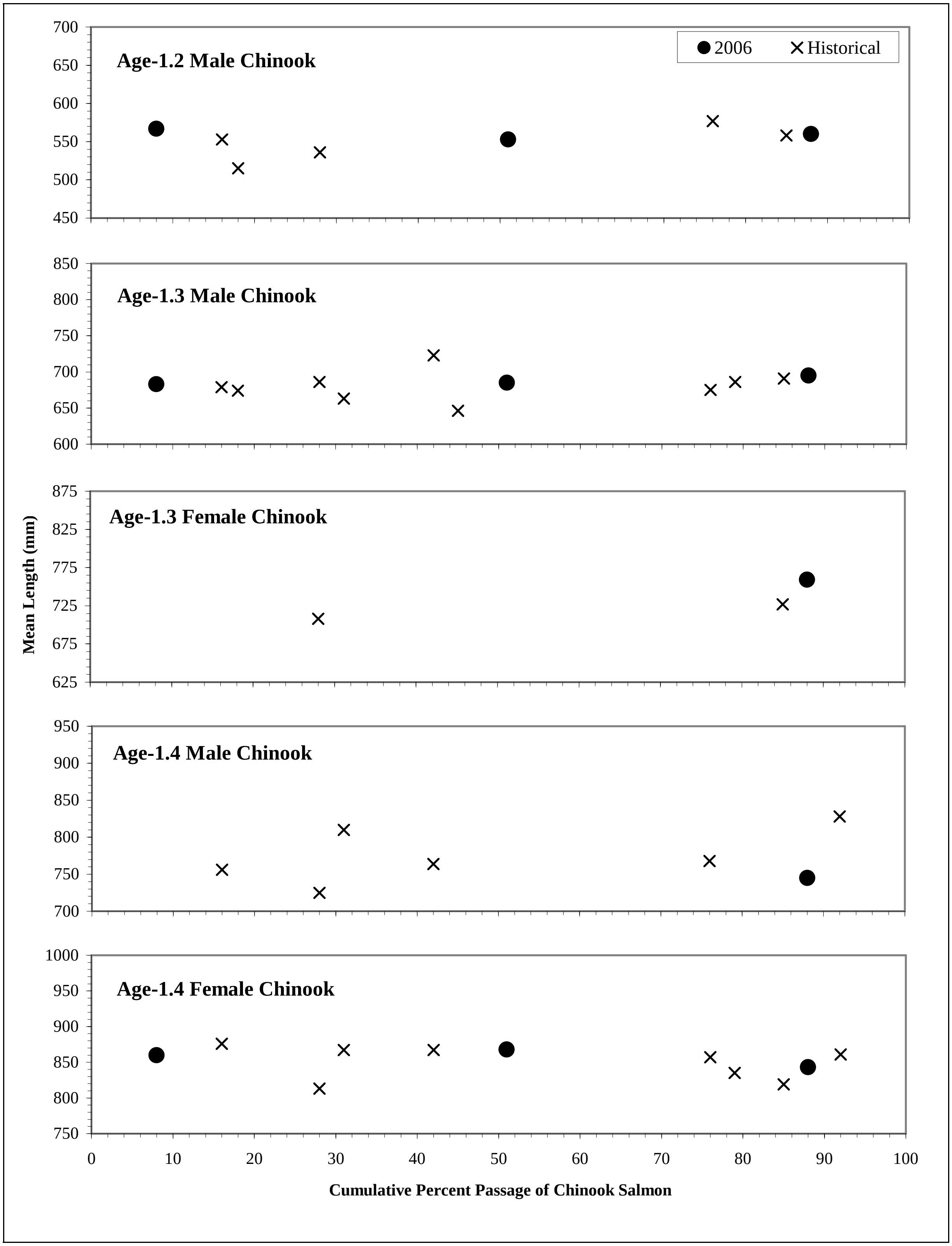


Figure 8.–Percentage of females per strata as determined by ASL sampling compared to visual identification at the Takotna River weir, 2006.



Note: Only samples greater than 6 fish were included in this figure.

Figure 9.–Historical intra-annual mean length-at-age of male and female Chinook salmon by cumulative percent passage at the Takotna River weir.

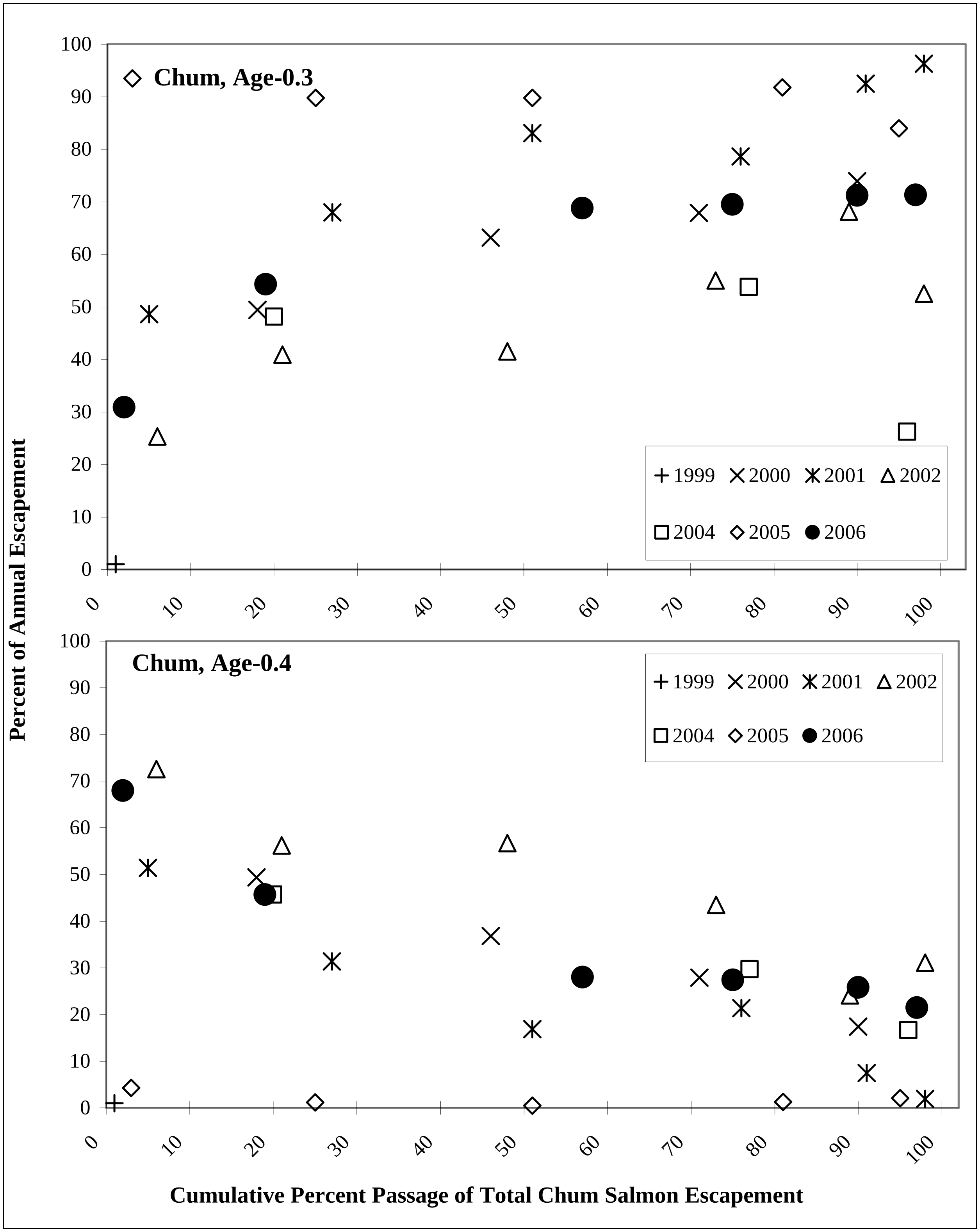


Figure 10.–Historical age composition by total cumulative percent passage for chum salmon at the Takotna River weir.

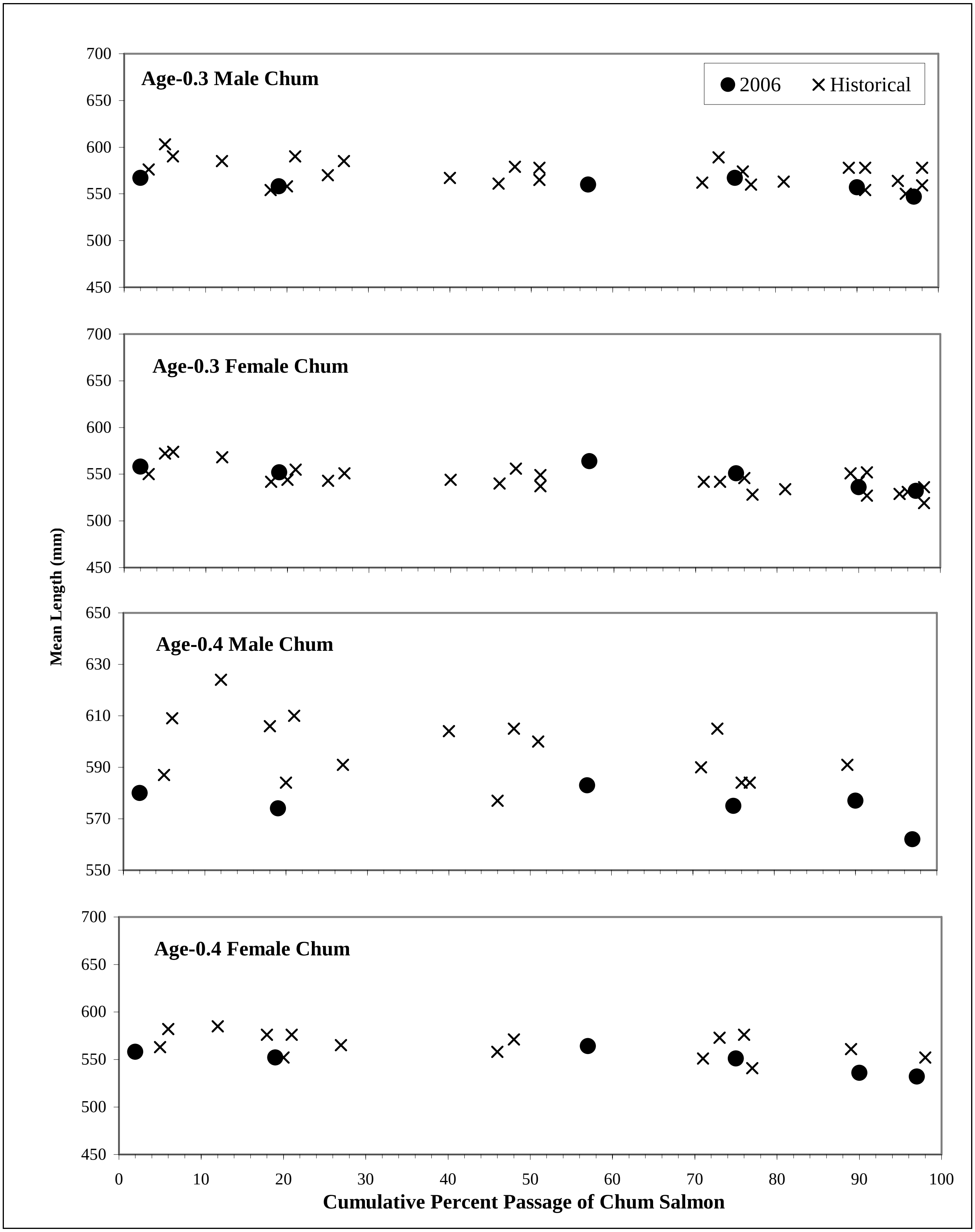


Figure 11.–Historical intra-annual mean length-at-age of male and female chum salmon by cumulative percent passage at the Takotna River weir.

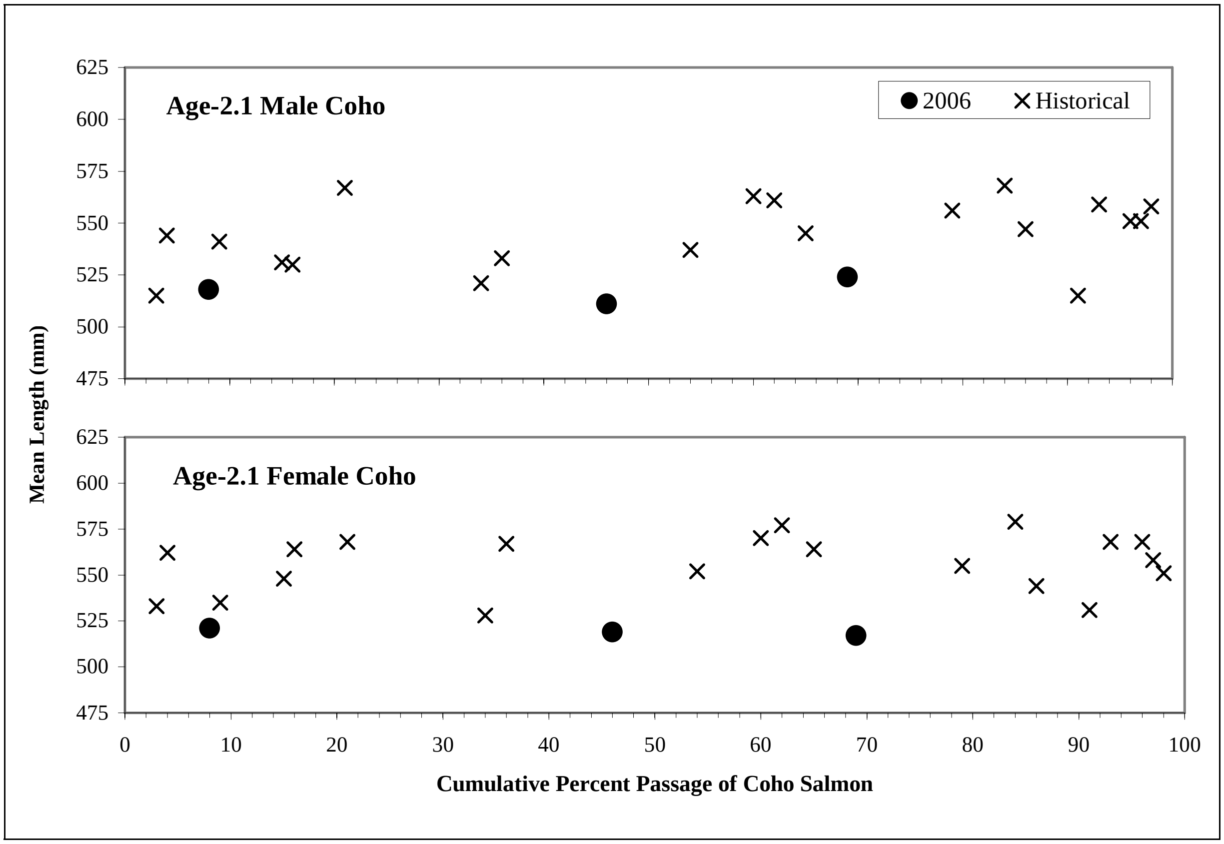


Figure 12.–Historical intra-annual mean length-at-age of male and female coho salmon by cumulative percent passage at the Takotna River weir.

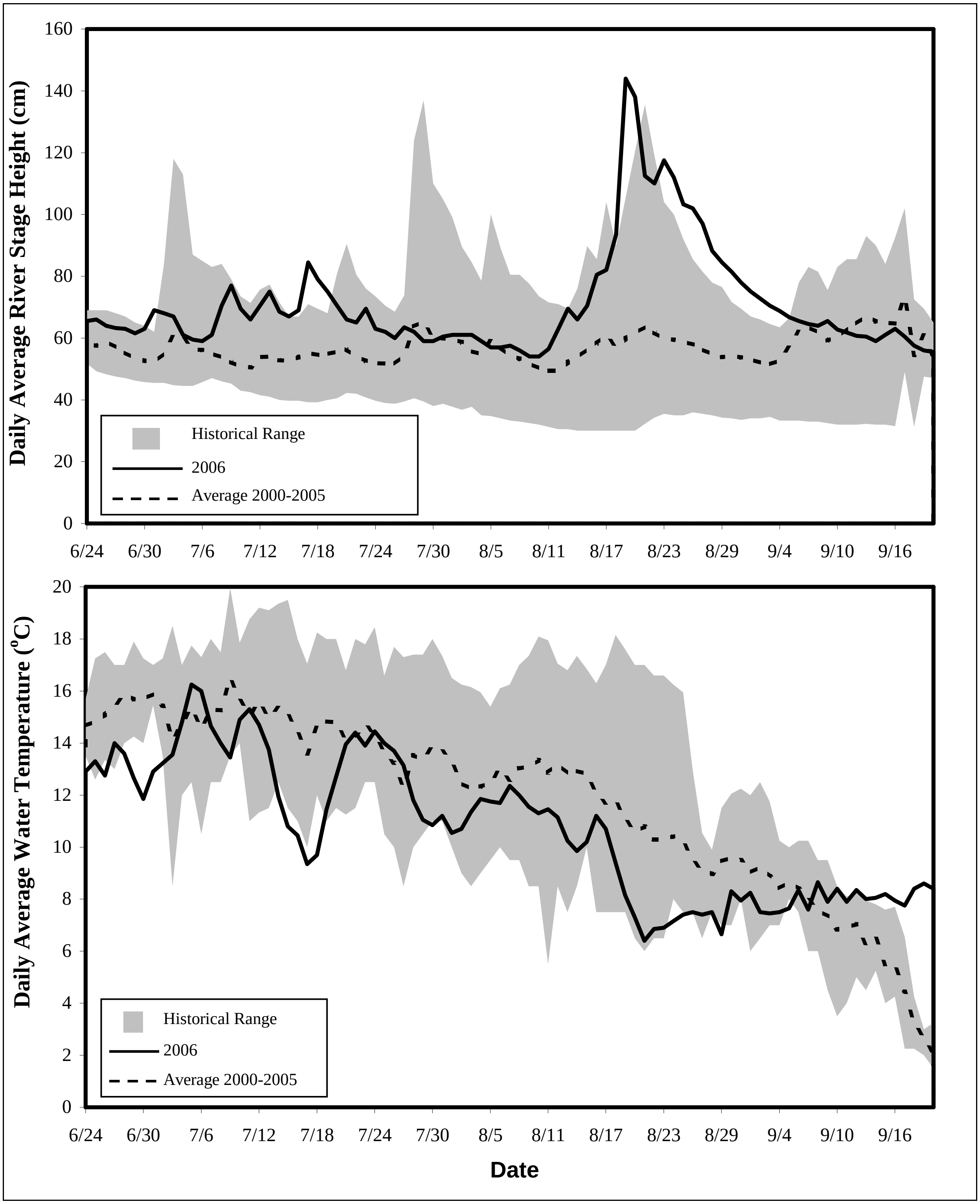


Figure 13.–Historical average, minimum, and maximum daily average river stage and water temperature at the Takotna River weir from 2000 to 2005, compared to daily average river stage and water temperature in 2006.

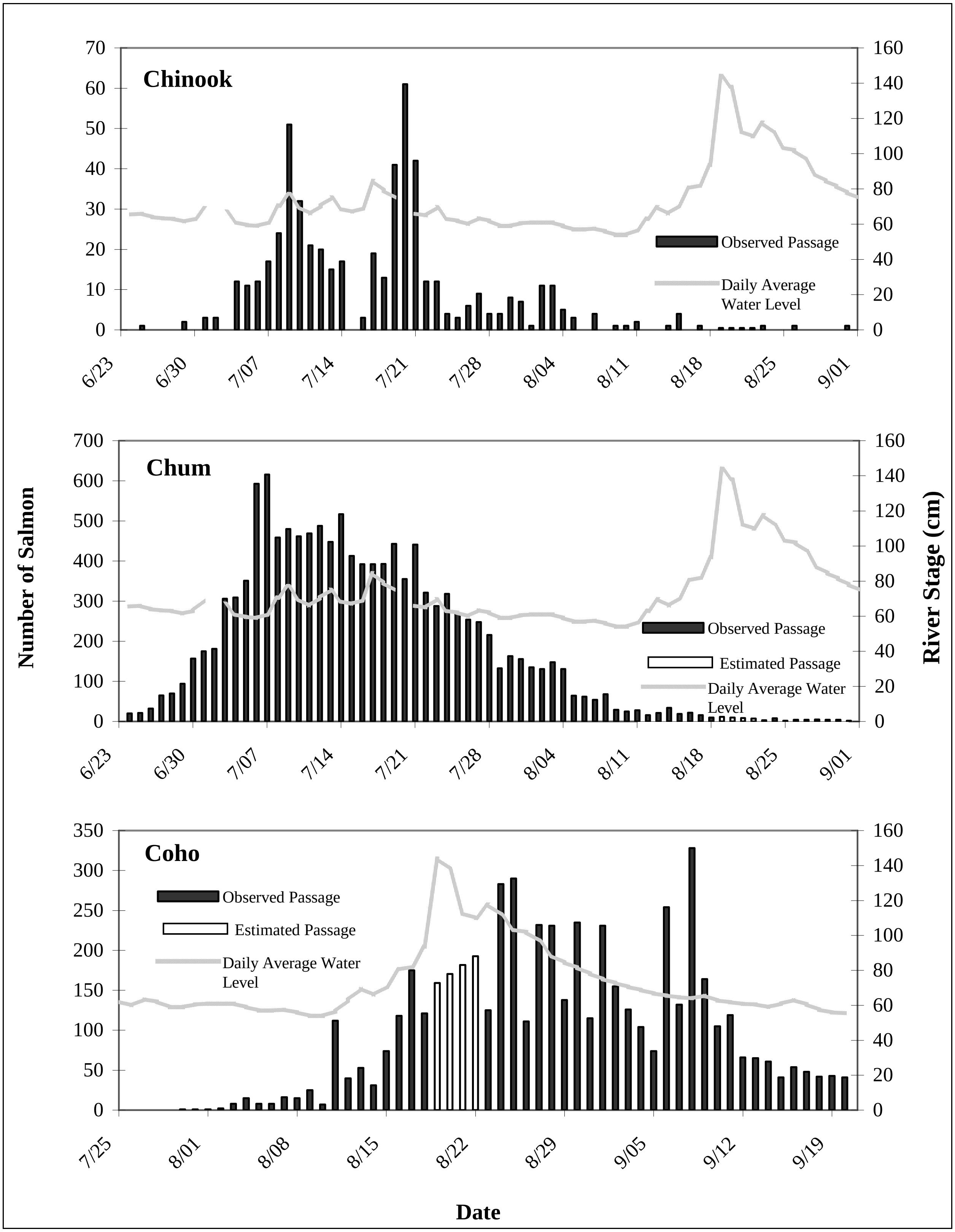


Figure 14.–Daily Chinook, chum, and coho salmon passage at the Takotna River weir relative to daily average river stage height, 2006.

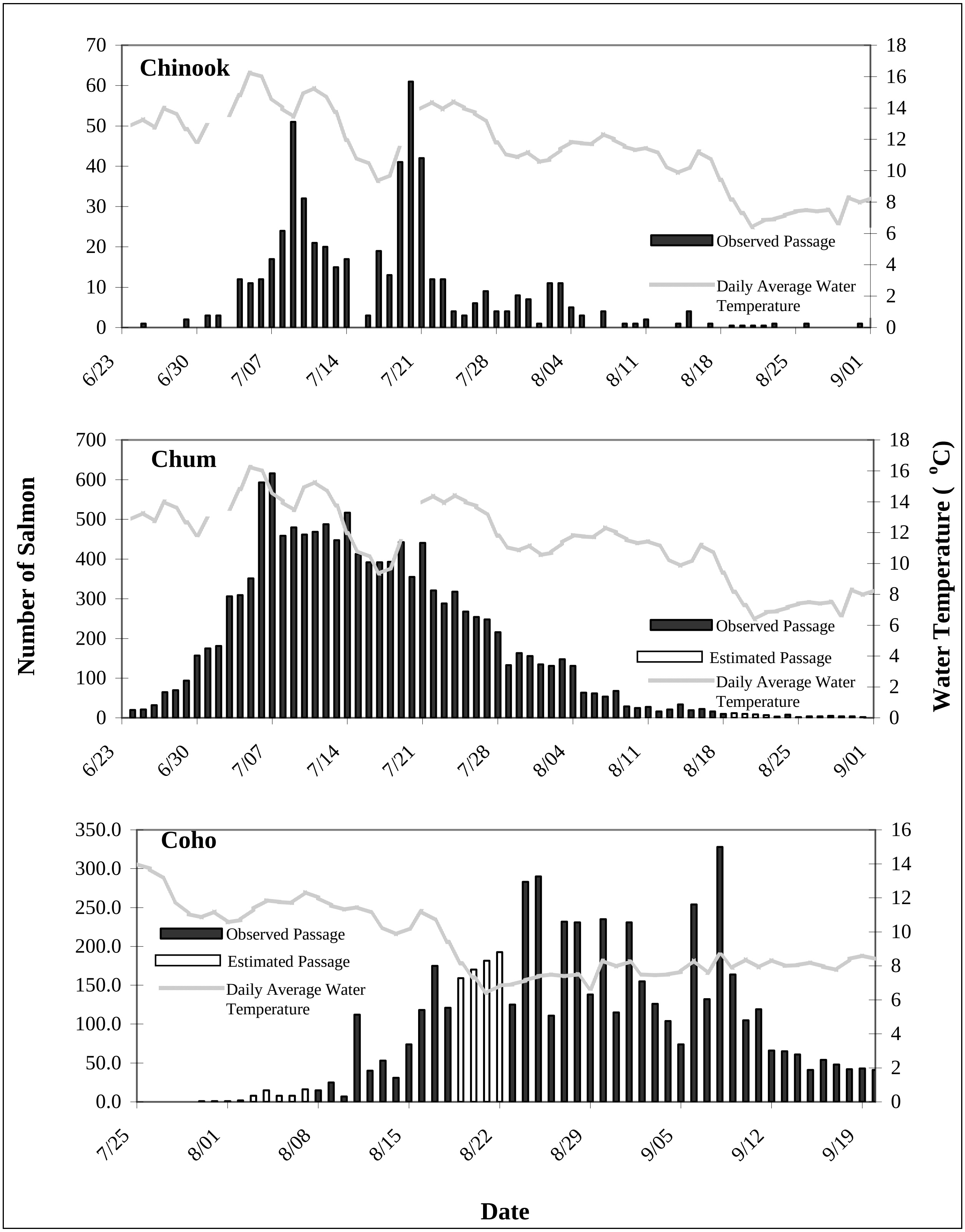
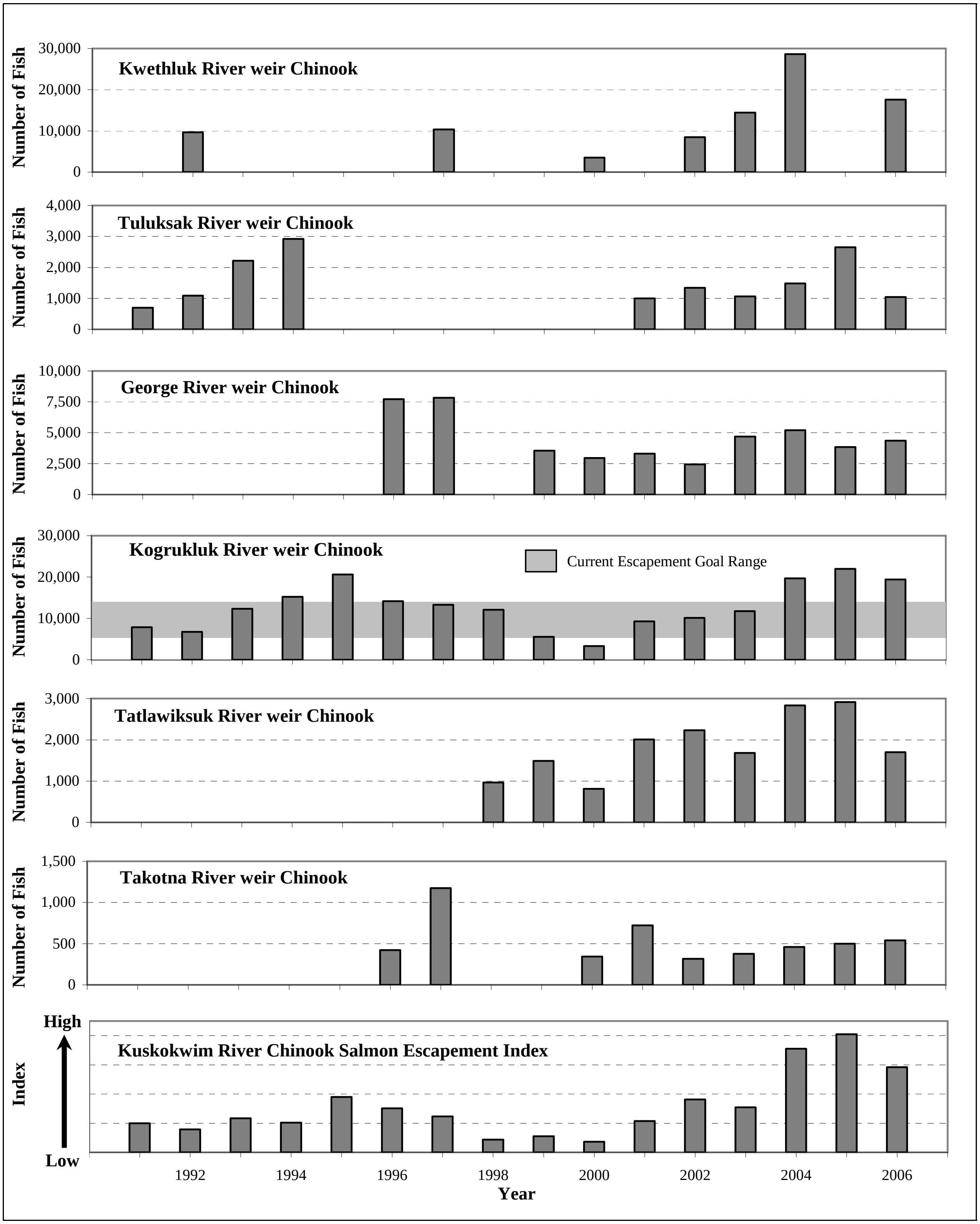
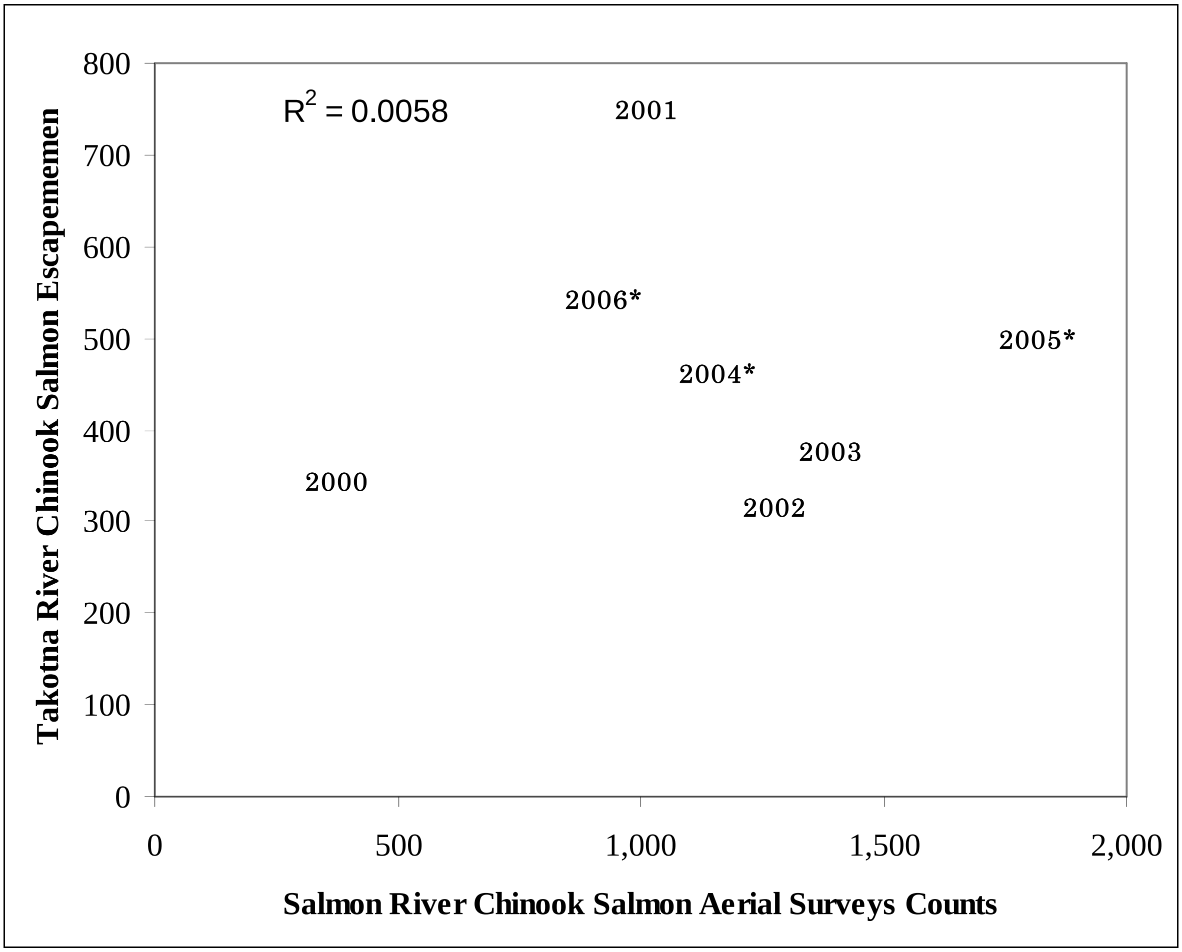


Figure 15.–Daily Chinook, chum, and coho salmon passage at the Takotna River weir relative to daily average water temperature, 2006.



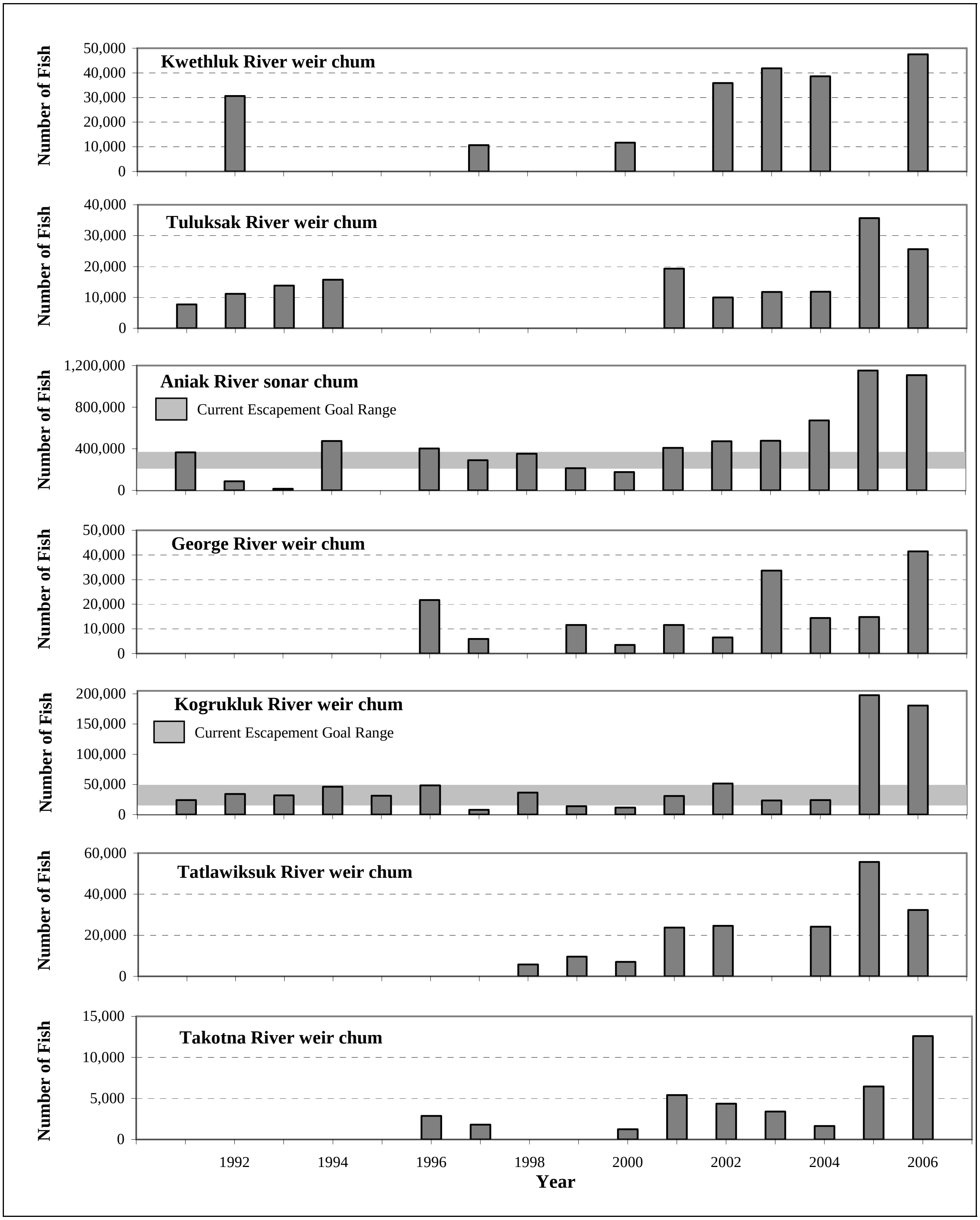
Source: Linderman and Bergstrom 2006.

Figure 16.–Historical annual Chinook salmon escapement into 6 Kuskokwim River tributaries and the annual Kuskokwim River Chinook salmon escapement index, 1991- 2006.



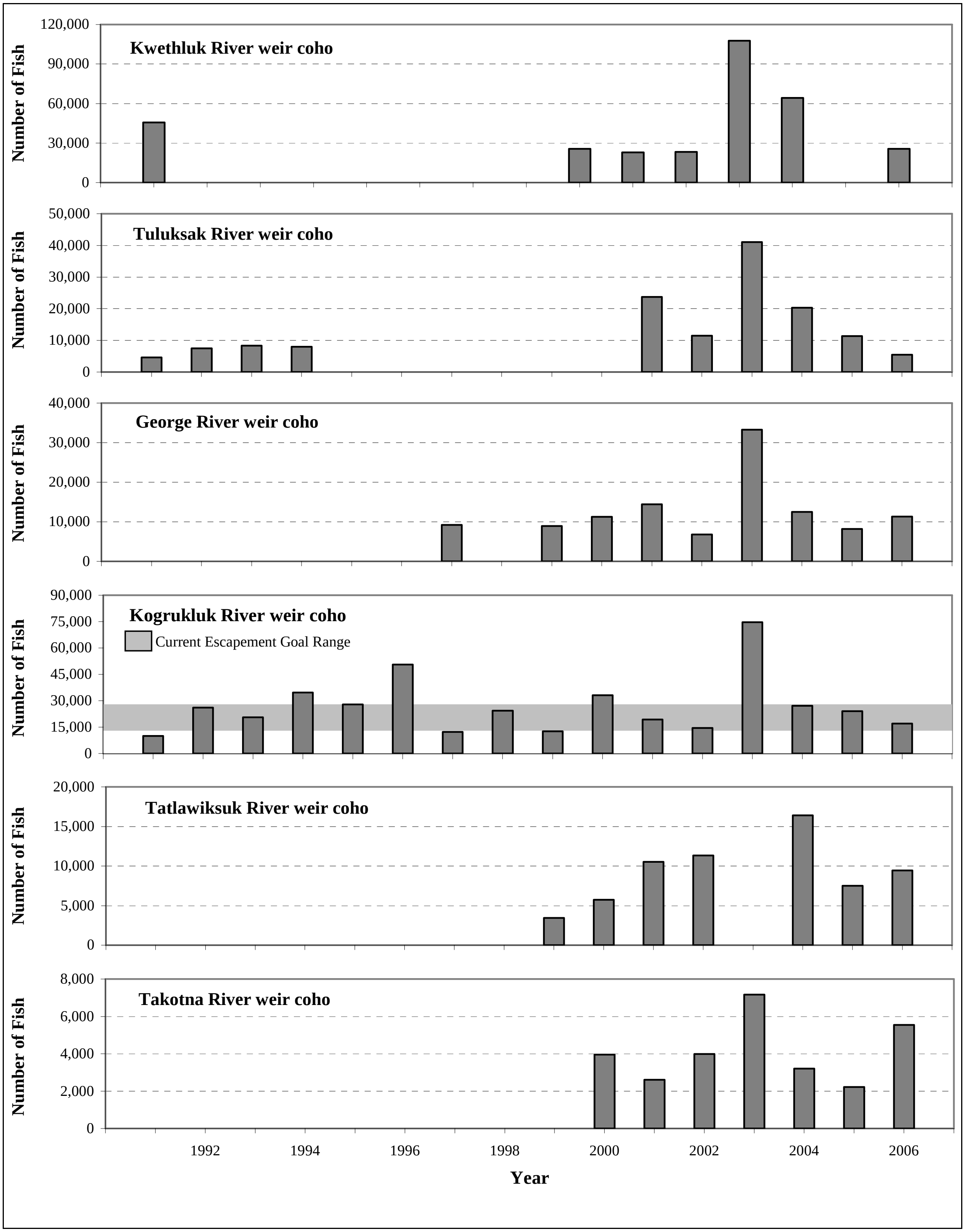
Note: An asterisk (*) denotes an incomplete survey.

Figure 17.–Comparison of Salmon River (Pitka Fork) aerial survey counts and Takotna River escapement counts for Chinook salmon, 2000–2006.



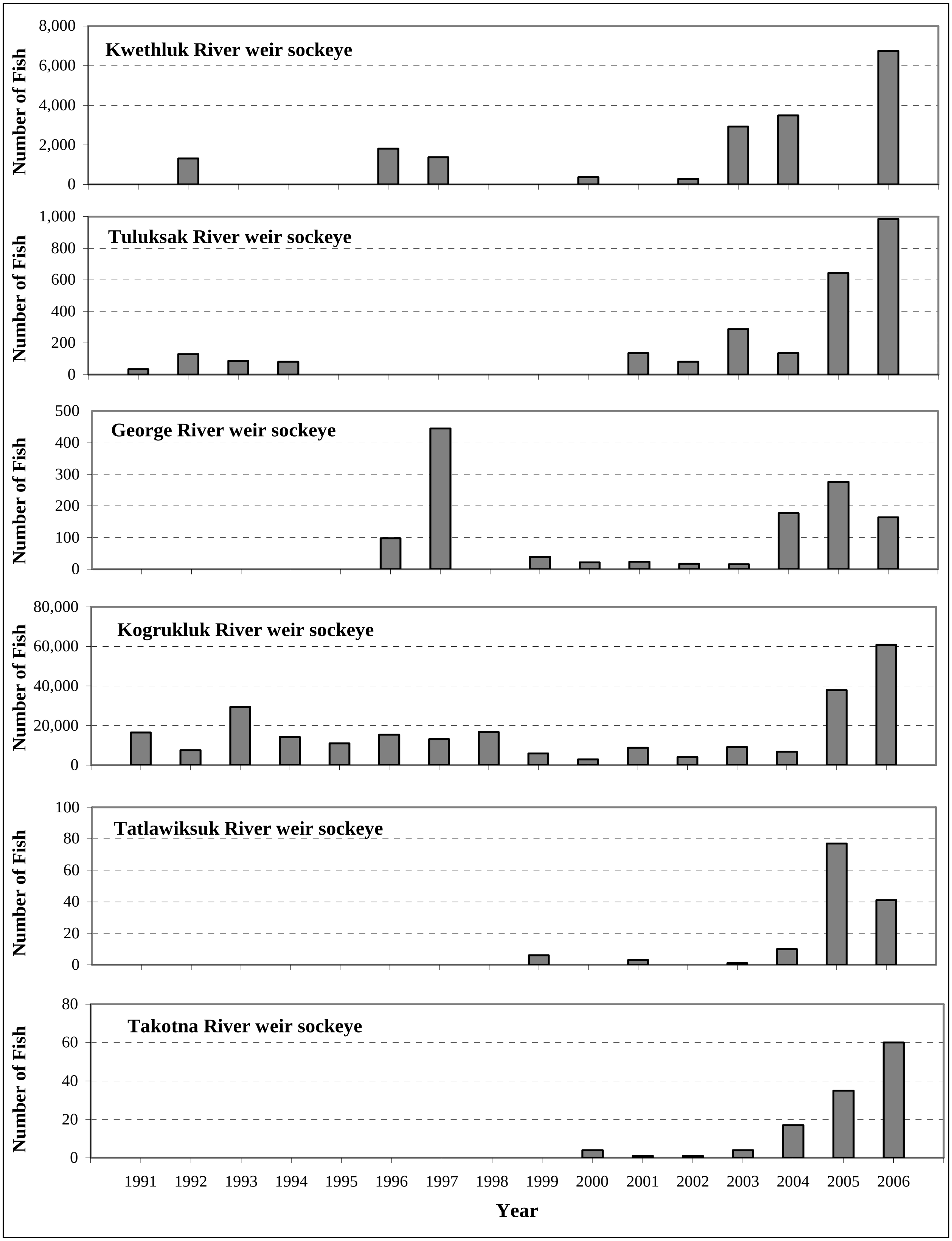
Source: Linderman and Bergstrom 2006.

Figure 18.–Historical annual chum salmon escapement into 7 Kuskokwim River tributaries, 1991–2006.



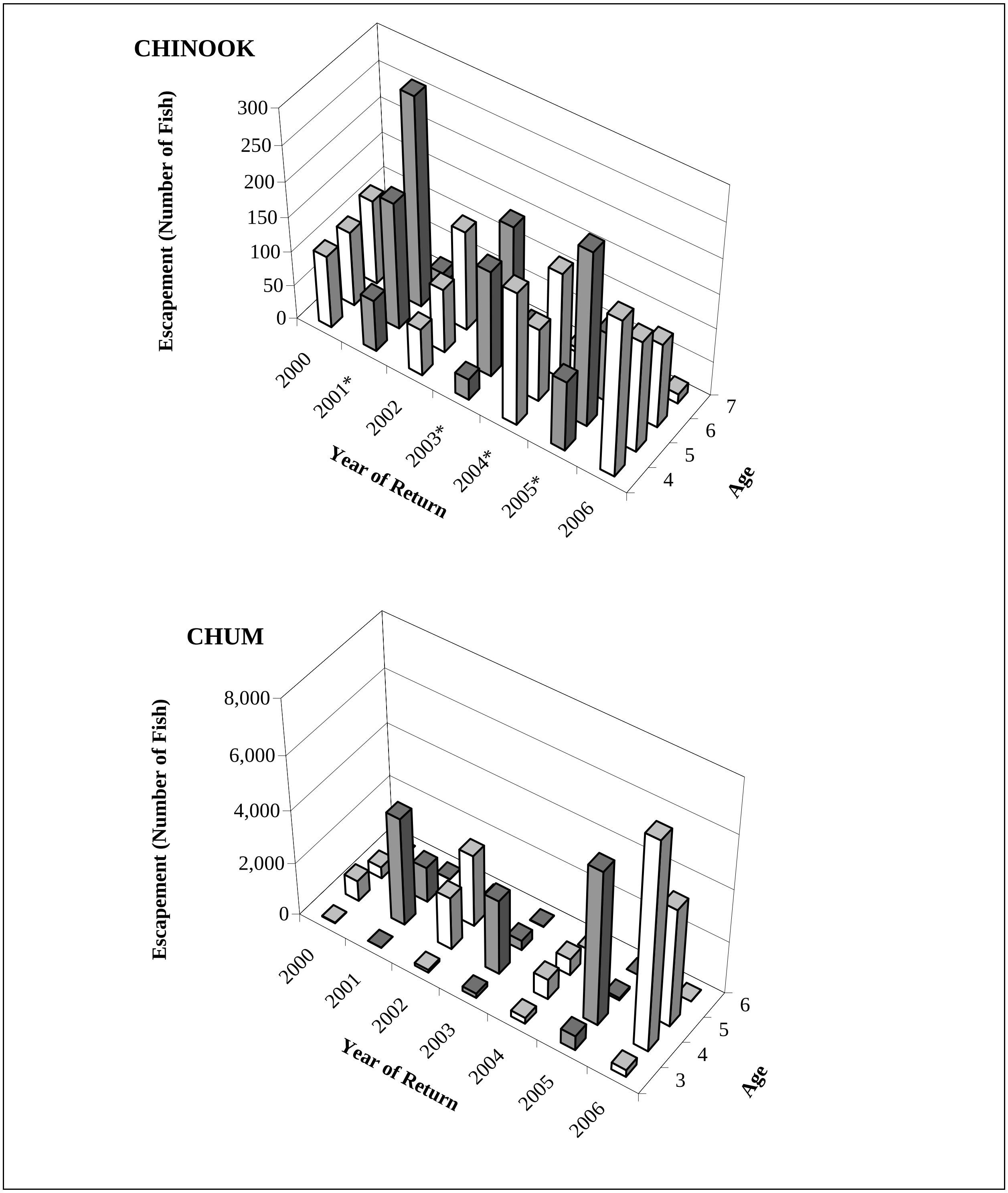
Source: Linderman and Bergstrom 2006.

Figure 19.–Historical annual coho salmon escapement into 6 Kuskokwim River tributaries, 1991–2006.



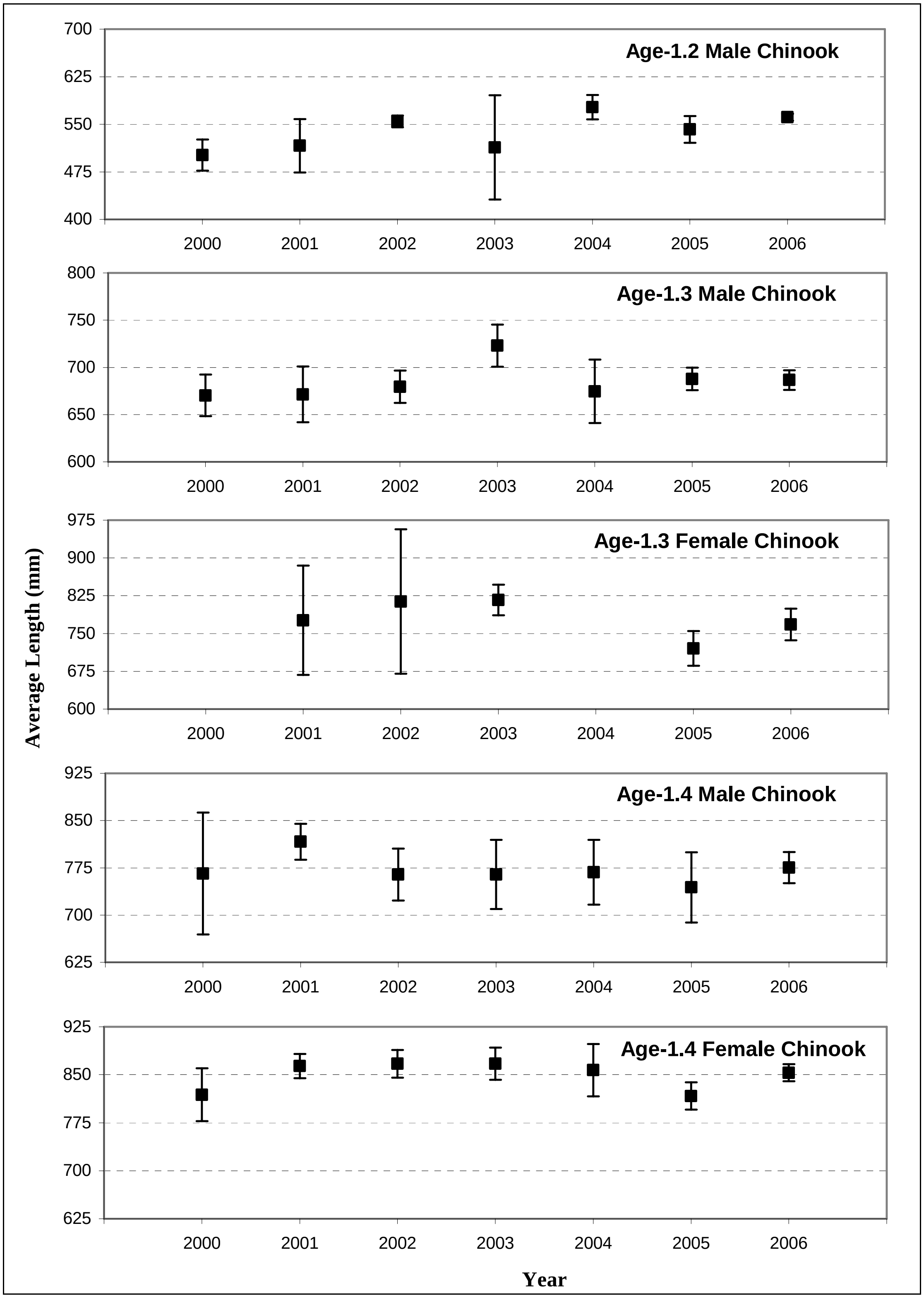
Source: Linderman and Bergstrom 2006.

Figure 20.–Historical annual sockeye salmon escapement into 6 Kuskokwim River tributaries, 1991–2006.



Note: Years with an asterisk (*) are years when the sample age composition was applied to total escapement even though sampling was not sufficient for temporal stratification.

Figure 21.–Historical Chinook and chum salmon age distribution for common age classes at the Takotna River weir.



Note: Except for 2000, 2002, and 2006, sampling goals were not achieved; the length data reported for other years represents only the average length in the sample.

Figure 22.–Historical average annual length with 95% confidence intervals for Chinook salmon at the Takotna River weir.

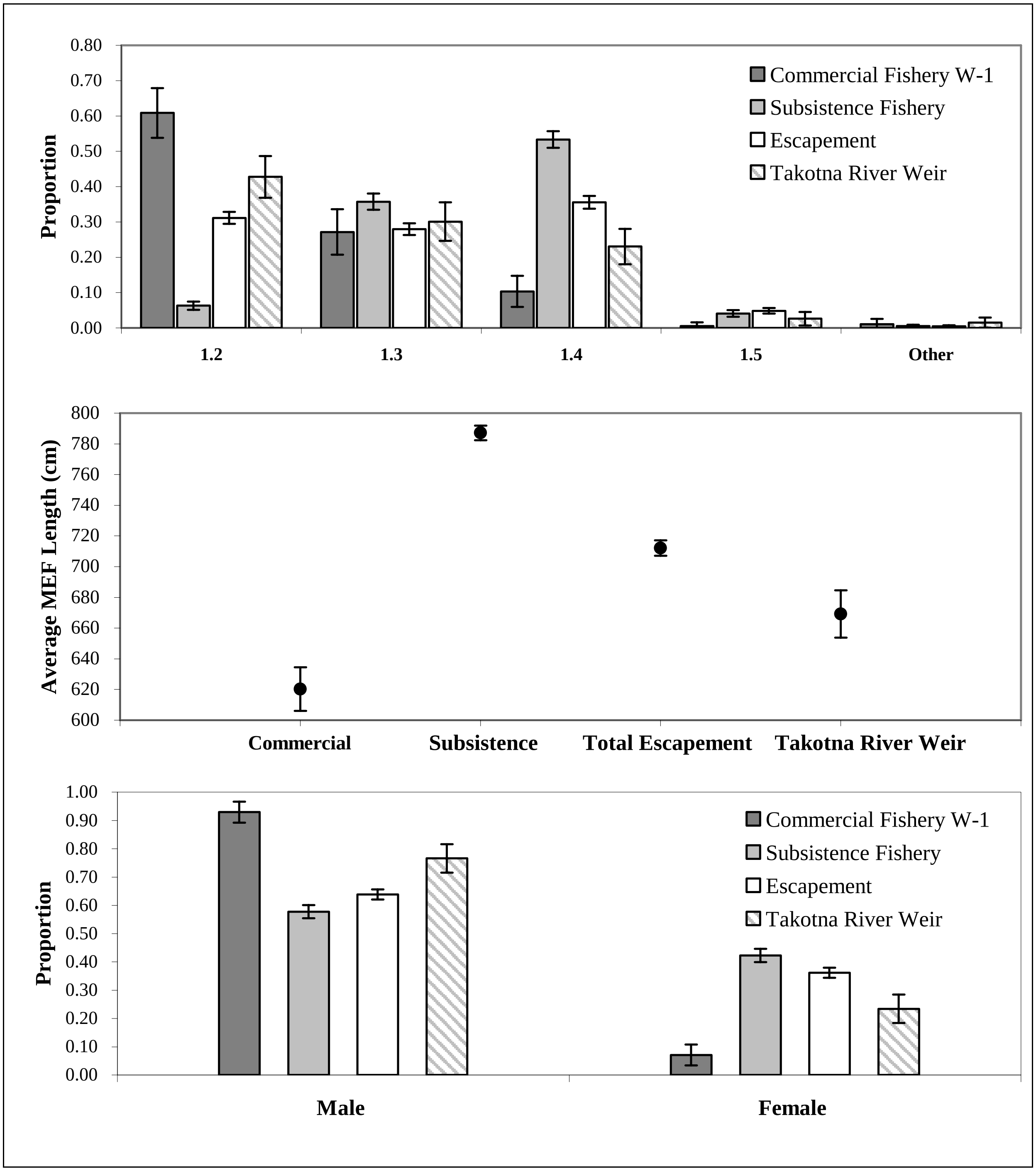


Figure 23.–ASL composition of the 2006 Kuskokwim River Chinook salmon commercial and subsistence harvests, total monitored escapement, and the Takotna River weir (+/- 95% confidence interval).

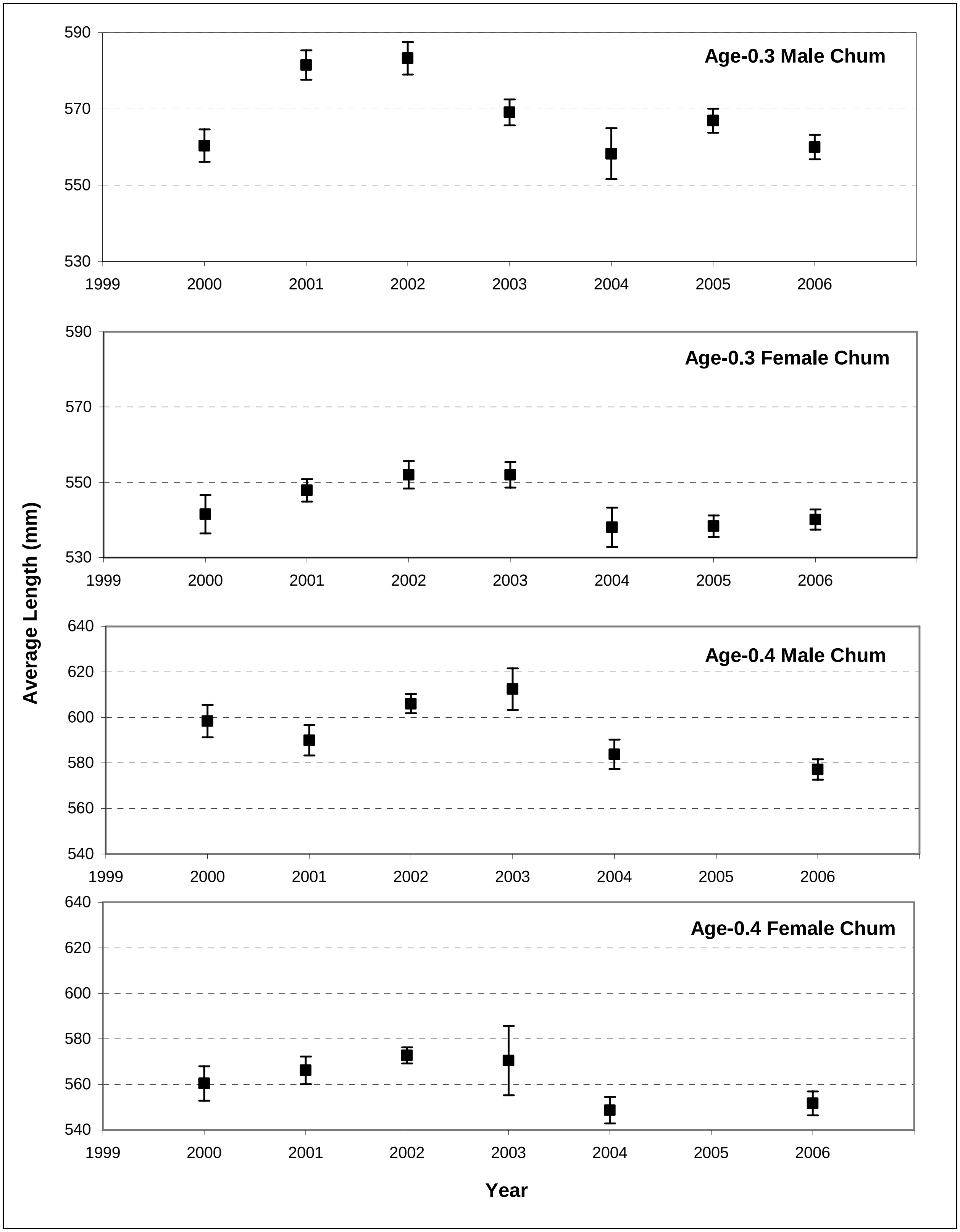


Figure 24.–Historical average annual length with 95% confidence intervals for chum salmon at the Takotna River weir.

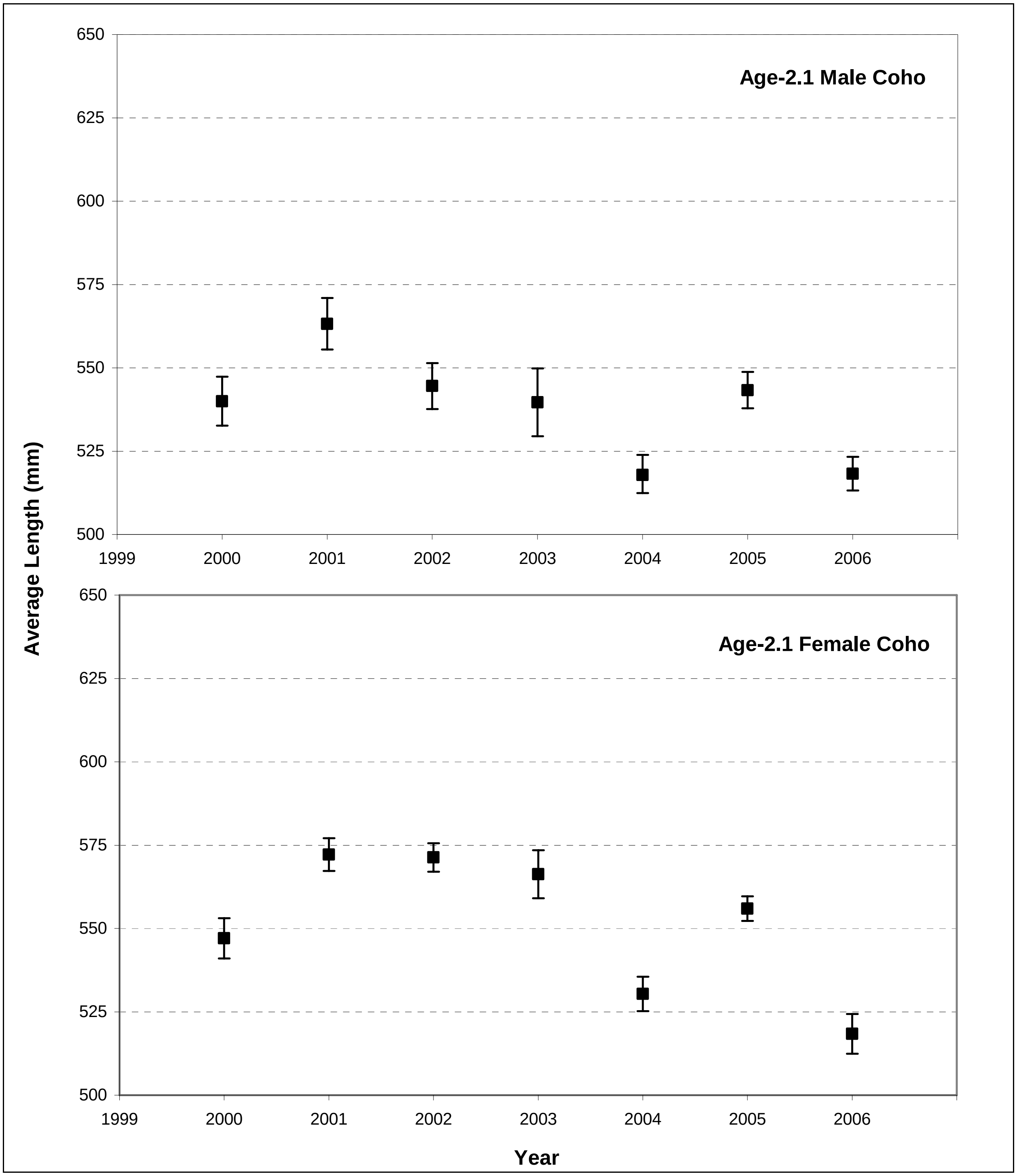


Figure 25.–Historical average annual length with 95% confidence intervals for coho salmon at the Takotna River weir.

APPENDIX A. HISTORICAL SALMON PASSAGE AT THE TAKOTNA RIVER WEIR

Appendix A1.–Historical daily Chinook salmon escapement at the Takotna River tower (1995–1997) and weir (2000–2006) during the current target operational period.

	Daily Passage										Cumulative Passage									
Date	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006
6/24	[a]	0	12	0	1	1	[a]	1	1	0		0	12	0	1	1		1	1	0
6/25	[a]	0	30	2	3	0	[a]	2	0	1		0	42	2	4	1		3	1	1
6/26	[a]	9	24	2	1	0	[a]	3	4	0		9	66	4	5	1		6	5	1
6/27	[a]	17	9	1	4	2	[a]	7	3	0		26	75	5	9	3		13	8	1
6/28	[a]	8	33	0	1	4	[a]	16	23	0		34	108	5	10	7		29	31	1
6/29	[a]	21	36	1	1	3	[a]	4	14	2		55	144	6	11	10		33	45	3
6/30	[a]	18	57	1	13	1	[a]	16	50	0		73	201	7	24	11		49	95	3
7/1	[a]	15	0	0	17	5	[a]	2	1	3		88	201	7	41	16		51	96	6
7/2	[a]	12	30	15	4	0	10 [b]	1	1	3		100	231	22	45	16	10	52	97	9
7/3	[a]	12	72	16	23	1	5 [b]	4	1	0		112	303	38	68	17	15	56	98	9
7/4	[a]	73	66	3	10	2	0 [b]	23	10	12		185	369	41	78	19	15	79	108	21
7/5	[a]	39	54	14	1	3	6	6	13	11		224	423	55	79	22	21	85	121	32
7/6	[a]	10	54	7	3	11	6	17	21	12		234	477	62	82	33	27	102	142	44
7/7	4	37	33	12	15	17	6	6	15	17	4	271	510	74	97	50	33	108	157	61
7/8	7	24	54	37	110	32	10	19	21	24	11	295	564	111	207	82	43	127	178	85
7/9	2	3	69	9	17	7	37	147	11	51	13	298	633	120	224	89	80	274	189	136
7/10	8	4	51	3	69	2	23	16	38	32	21	302	684	123	293	91	103	290	227	168
7/11	41	5	69	8	9	93	10	15	22	21	62	307	753	131	302	184	113	305	249	189
7/12	8	5	48	22	30	51	16	14	17	20	70	312	801	153	332	235	129	319	266	209
7/13	12	7	24	1	45	2	24	3	56	15	82	319	825	154	377	237	153	322	322	224
7/14	17	7	66	3	29	2	5	16	17	17	99	326	891	157	406	239	158	338	339	241
7/15	9	9	27	4	41	2	2	12	3	0	108	335	918	161	447	241	160	350	342	241
7/16	6	0	12	4	28	0	5	9	43	3	114	335	930	165	475	241	165	359	385	244
7/17	0	20	36	2	17	3	9	4	15	19	114	355	966	167	492	244	174	363	400	263
7/18	12	11	48	6	14	5	22	9	6	13	126	366	1,014	173	506	249	196	372	406	276
7/19	12	9	12	4	31	4	26	1	18	41	138	375	1,026	177	537	253	222	373	424	317
7/20	6	8	15	8	26	9	26	3	7	61	144	383	1,041	185	563	262	248	376	431	378
7/21	0	7	3	7	23	5	8	6	1	42	144	390	1,044	192	586	267	256	382	432	420
7/22	9	5	12	39	21	2	15	2	3	12	153	395	1,056	231	607	269	271	384	435	432
7/23	0	4	9	2	13	0	6	26	7	12	153	399	1,065	233	620	269	277	410	442	444
7/24	0	3	18	5	17	0	11	1	4	4	153	402	1,083	238	637	269	288	411	446	448
7/25	0	0	15	17	10	6	7	0	7	3	153	402	1,098	255	647	275	295	411	453	451
7/26	0	0 [c]	18	3	11	5	4	9	0	6	153	402	1,116	258	658	280	299	420	453	457
7/27	0	0 [c]	12	9	6	2	9	2	3	9	153	402	1,128	267	664	282	308	422	456	466
7/28	0	1 [c]	6	5	11	1	6 [c]	3	9	4	153	403	1,134	272	675	283	314	425	465	470

-continued-

Appendix A1.–Page 2 of 3.

	Daily Passage										Cumulative Passage									
Date	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006
7/29	0	0 [c]	15	9	3	8	6 [c]	2	6	4	153	403	1,149	281	678	291	320	427	471	474
7/30	3	1 [c]	0	5	2	5	6 [c]	12	0	8	156	404	1,149	286	680	296	326	439	471	482
7/31	0	5 [c]	0	2	4	0	5 [c]	0	2	7	156	409	1,149	288	684	296	331	439	473	489
8/1	0	2 [c]	3	1	1	2	5 [d]	0	1	1	156	411	1,152	289	685	298	336	439	474	490
8/2	0	1 [c]	6	1	3	0	4	1	0	11	156	412	1,158	290	688	298	340	440	474	501
8/3	0	0 [c]	3	5	0	0	5	0	1	11	156	412	1,161	295	688	298	345	440	475	512
8/4	0	2 [c]	0	8	2	1	5	1	1	5	156	414	1,161	303	690	299	350	441	476	517
8/5	0 [c]	1 [c]	[a]	7	1	0	4	6	3	3	156	415		310	691	299	354	447	479	520
8/6	0 [c]	0 [c]	[a]	4	4	1	1	2	3	0	156	415		314	695	300	355	449	482	520
8/7	0	0 [c]	[a]	1	1	2	2	1	1	4	156	415		315	696	302	357	450	483	524
8/8	0 [c]	2 [c]	[a]	7	3	0	5	0	0	0	156	417		322	699	302	362	450	483	524
8/9	0 [c]	0 [c]	[a]	7	1	3	2	2	1	1	156	417		329	700	305	364	452	484	525
8/10	0	1 [c]	[a]	0	2	2	0	1	1	1	156	418		329	702	307	364	453	485	526
8/11	0 [c]	0 [c]	[a]	3	1	0	0	0	1	2	156	418		332	703	307	364	453	486	528
8/12	0	0 [c]	[a]	6	2	4	0	0	0	0	156	418		338	705	311	364	453	486	528
8/13	0 [c]	1 [c]	[a]	2	1	1	0	2	1	0	156	418		340	706	312	364	455	487	528
8/14	0 [c]	1 [c]	[a]	1	1	0	2	0	0	1	156	419		341	707	312	366	455	487	529
8/15	0	1 [c]	[a]	0	0	1	0	1	0	4	156	420		341	707	313	366	456	487	533
8/16	0 [c]	0 [c]	[a]	0	1	0	0	0	2	0	156	420		341	708	313	366	456	489	533
8/17	0 [c]	0 [c]	[a]	0	0	0	1	0	0	1	156	420		341	708	313	367	456	489	534
8/18	0 [c]	0 [c]	[a]	2	1	0	2	1	0	0	156	420		343	709	313	369	457	489	534
8/19	0 [c]	1 [c]	[a]	0	0	0	1	1	0	1 [c]	156	421		343	709	313	370	458	489	535
8/20	0 [c]	0 [c]	[a]	0	1 [d]	0	1	1	0	0 [c]	156	421		343	710	313	371	459	489	535
8/21	0	1 [c]	[a]	0	1 [c]	0	1	0	0	0 [c]	156	422		343	711	313	372	459	489	536
8/22	0 [c]	0 [c]	[a]	0	1 [c]	0	0	0	0	1 [d]	156	422		343	712	313	372	459	489	536
8/23	0	0 [c]	[a]	0	1	0	2	0	0	1	156	422		343	713	313	374	459	489	537
8/24	0 [c]	0 [c]	[a]	0	0	0	0	1	2	0	156	422		343	713	313	374	460	491	537
8/25	0	0 [c]	[a]	0	0	1	1	0	1	0	156	422		343	713	314	375	460	492	537
8/26	0 [c]	0 [c]	[a]	0	1	0	1	1	1	1	156	422		343	714	314	376	461	493	538
8/27	0 [c]	0 [c]	[a]	1	1	0	1	0	1	0	156	422		344	715	314	377	461	494	538
8/28	0	0 [c]	[a]	0	1	0	0	0	1	0	156	422		344	716	314	377	461	495	538
8/29	0	0 [c]	[a]	0	1	0	0	0	1	0	156	422		344	717	314	377	461	496	538
8/30	0	0 [c]	[a]	0	1	0	0	0	0	0	156	422		344	718	314	377	461	496	538
8/31	0	0 [c]	[a]	0	1	0	0	0	0	1	156	422		344	719	314	377	461	496	539

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	Daily Passage										Cumulative Passage									
Date	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006
9/1	0	0 [c]	[a]	0	0	0	1	0	0	0	156	422		344	719	314	378	461	496	539
9/2	[a]	0 [c]	[a]	0	0	0	0	0	0	0	156	422		344	719	314	378	461	496	539
9/3	[a]	0 [c]	[a]	0	1	0	0	0	0	0		422		344	720	314	378	461	496	539
9/4	[a]	0 [c]	[a]	0	1	0	0	0	1	0		422		344	721	314	378	461	497	539
9/5	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		344	721	314	378	461	497	539
9/6	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		344	721	314	378	461	497	539
9/7	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		344	721	314	378	461	497	539
9/8	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		344	721	314	378	461	497	539
9/9	[a]	0 [c]	[a]	1	0	0	0	0	0	0		422		345	721	314	378	461	497	539
9/10	[a]	0 [c]	[a]	0	0	0	0	0	1	0		422		345	721	314	378	461	498	539
9/11	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		345	721	314	378	461	498	539
9/12	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		345	721	314	378	461	498	539
9/13	[a]	0 [c]	[a]	0	0	1	0	0	1	0		422		345	721	315	378	461	499	539
9/14	[a]	0 [c]	[a]	0	0	0	0	0	0	0		422		345	721	315	378	461	499	539
9/15	[a]	0 [c]	[a]	0	0 [c]	1	0	0	0	0		422		345	721	316	378	461	499	539
9/16	[a]	0 [c]	[a]	0	0 [c]	0	0	0	0	0		422		345	721	316	378	461	499	539
9/17	[a]	0 [c]	[a]	0	0 [c]	0	0	0	0	0		422		345	721	316	378	461	499	539
9/18	[a]	0 [c]	[a]	0	0 [c]	0	0	0	0	0		422		345	721	316	378	461	499	539
9/19	[a]	0 [c]	[a]	0	0 [c]	0	0	0 [c]	0	0		422		345	721	316	378	461	499	539
9/20	[a]	0 [c]	[a]	0	0 [c]	0	0	0 [c]	0	0		422		345	721	316	378	461	499	539

Note: The tower was operated for only 8 days in 1998; hence, that year is excluded from the table. The sum of daily passages might differ from the cumulative passage due to rounding error.

[a] The weir or tower was not operational; daily passage was not estimated.

[b] Partial day count; passage was not estimated.

[c] The weir or tower was not operational; daily passage was estimated.

[d] Partial day count; passage was estimated.

Appendix A2.–Historical daily chum salmon escapement at the Takotna River tower (1995–1997) and weir (2000–2006) during the current target operational period.

	Daily Passage										Cumulative Passage									
Date	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006
6/24	[a]	0	12	1	3	29	0 [b]	4	2	20		0	12	1	3	29	0	4	2	20
6/25	[a]	0	30	24	9	55	0 [b]	8	4	21		0	42	25	12	84	0	12	6	41
6/26	[a]	9	24	23	10	55	1 [b]	31	9	32		9	66	48	22	139	1	43	15	73
6/27	[a]	17	9	11	12	111	5 [b]	28	9	65		26	75	59	34	250	6	71	24	138
6/28	[a]	8	33	9	4	116	7 [b]	32	14	70		34	108	68	38	366	13	103	38	208
6/29	[a]	21	36	6	19	168	4 [b]	29	16	94		55	144	74	57	534	17	132	54	302
6/30	[a]	18	57	6	20	147	12 [b]	34	40	157		73	201	80	77	681	29	166	94	459
7/1	[a]	15	0	10	42	180	10 [b]	54	24	175		88	201	90	119	861	39	220	118	634
7/2	[a]	12	30	18	24	72	40 [c]	41	41	181		100	231	108	143	933	79	261	159	815
7/3	[a]	12	72	17	47	145	57 [c]	59	47	306		112	303	125	190	1,078	136	320	206	1,121
7/4	[a]	73	66	39	40	94	54 [c]	58	86	309		185	369	164	230	1,172	190	378	292	1,430
7/5	[a]	39	54	12	21	250	111	48	222	351		224	423	176	251	1,422	301	426	514	1,781
7/6	[a]	10	54	45	60	204	120	108	205	593		234	477	221	311	1,626	421	534	719	2,374
7/7	4	37	33	44	106	251	126	66	301	616	4	271	510	265	417	1,877	547	600	1,020	2,990
7/8	7	24	54	101	188	124	137	65	398	459	11	295	564	366	605	2,001	684	665	1,418	3,449
7/9	2	3	69	49	78	110	142	92	200	480	13	298	633	415	683	2,111	826	757	1,618	3,929
7/10	8	4	51	27	204	205	88	87	327	462	21	302	684	442	887	2,316	914	844	1,945	4,391
7/11	41	5	69	58	198	259	47	74	193	469	62	307	753	500	1,085	2,575	961	918	2,138	4,860
7/12	8	5	48	29	372	266	77	73	223	488	70	312	801	529	1,457	2,841	1,038	991	2,361	5,348
7/13	12	7	24	49	275	80	62	23	220	448	82	319	825	578	1,732	2,921	1,100	1,014	2,581	5,796
7/14	17	7	66	50	309	103	140	33	189	517	99	326	891	628	2,041	3,024	1,240	1,047	2,770	6,313
7/15	9	9	27	35	265	97 [c]	129	22	241	413	108	335	918	663	2,306	3,121	1,369	1,069	3,011	6,726
7/16	6	0	12	33	257	88	155	31	291	392	114	335	930	696	2,563	3,209	1,524	1,100	3,302	7,118
7/17	0	20	36	51	206	117	150	57	414	392	114	355	966	747	2,769	3,326	1,674	1,157	3,716	7,510
7/18	12	11	48	34	264	73	172	92	301	393	126	366	1,014	781	3,033	3,399	1,846	1,249	4,017	7,903
7/19	12	9	12	59	352	161	187	29	373	443	138	375	1,026	840	3,385	3,560	2,033	1,278	4,390	8,346
7/20	6	8	15	50	301	109	231	36	313	355	144	383	1,041	890	3,686	3,669	2,264	1,314	4,703	8,701
7/21	0	7	3	43	212	72	155	15	142	441	144	390	1,044	933	3,898	3,741	2,419	1,329	4,845	9,142
7/22	9	5	12	53	215	95	168	25	240	321	153	395	1,056	986	4,113	3,836	2,587	1,354	5,085	9,463
7/23	0	4	9	33	165	79	87	58	153	288	153	399	1,065	1,019	4,278	3,915	2,674	1,412	5,238	9,751
7/24	0	3	18	23	168	67	69	33	122	318	153	402	1,083	1,042	4,446	3,982	2,743	1,445	5,360	10,069
7/25	0	0	15	25	145	62	63	15	127	268	153	402	1,098	1,067	4,591	4,044	2,806	1,460	5,487	10,337
7/26	0	0 [b]	18	20	93	53	53	24	141	254	153	402	1,116	1,087	4,684	4,097	2,859	1,484	5,628	10,591
7/27	0	0 [b]	12	14	117	23	53	13	93	248	153	402	1,128	1,101	4,801	4,120	2,912	1,497	5,721	10,839
7/28	0	1 [b]	6	11	135	49	50 [b]	13	150	216	153	403	1,134	1,112	4,936	4,169	2,962	1,510	5,881	11,055

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	Daily Passage										Cumulative Passage									
Date	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006	1995	1996	1997	2000	2001	2002	2003	2004	2005	2006
7/29	0	0 [b]	15	18	58	39	46 [b]	17	121	133	153	403	1,149	1,130	4,994	4,208	3,008	1,527	6,002	11,188
7/30	3	1 [b]	0	12	64	21	43 [b]	26	56	163	156	404	1,149	1,142	5,058	4,229	3,051	1,553	6,058	11,351
7/31	0	5 [b]	0	10	68	15	39 [b]	17	55	156	156	409	1,149	1,152	5,126	4,244	3,090	1,570	6,113	11,507
8/1	0	2 [b]	3	3	38	21	36 [c]	12	33	135	156	411	1,152	1,155	5,164	4,265	3,126	1,582	6,146	11,642
8/2	0	1 [b]	6	12	30	22	29	8	37	131	156	412	1,158	1,167	5,194	4,287	3,155	1,590	6,183	11,773
8/3	0	0 [b]	3	2	34	15	35	3	34	148	156	412	1,161	1,169	5,228	4,302	3,190	1,593	6,217	11,921
8/4	0	2 [b]	0	22	30	17	32	5	44	131	156	414	1,161	1,191	5,258	4,319	3,222	1,598	6,261	12,052
8/5	0 [b]	1 [b]	[a]	5	38	5	44	4	24	64	156	415		1,196	5,296	4,324	3,266	1,602	6,285	12,116
8/6	0 [b]	0 [b]	[a]	11	25	4	28	5	37	62	156	415		1,207	5,321	4,328	3,294	1,607	6,322	12,178
8/7	0	0 [b]	[a]	5	16	13	18	4	24	54	156	415		1,212	5,337	4,341	3,312	1,611	6,346	12,232
8/8	0 [b]	2 [b]	[a]	11	11	3	11	2	23	68	156	417		1,223	5,348	4,344	3,323	1,613	6,369	12,300
8/9	0 [b]	0 [b]	[a]	5	13	5	6	3	5	29	156	417		1,228	5,361	4,349	3,329	1,616	6,374	12,329
8/10	0	1 [b]	[a]	10	8	6	6	1	10	25	156	418		1,238	5,369	4,355	3,335	1,617	6,384	12,354
8/11	0 [b]	0 [b]	[a]	6	8	6	6	2	10	28	156	418		1,244	5,377	4,361	3,341	1,619	6,394	12,382
8/12	0	0 [b]	[a]	6	5	4	4	4	8	16	156	418		1,250	5,382	4,365	3,345	1,623	6,402	12,398
8/13	0 [b]	1 [b]	[a]	2	2	2	10	2	8	21	156	418		1,252	5,384	4,367	3,355	1,625	6,410	12,419
8/14	0 [b]	1 [b]	[a]	0	3	0	7	1	5	34	156	419		1,252	5,387	4,367	3,362	1,626	6,415	12,453
8/15	0	1 [b]	[a]	0	2	0	6	0	5	19	156	420		1,252	5,389	4,367	3,368	1,626	6,420	12,472
8/16	0 [b]	0 [b]	[a]	0	1	3	5	0	3	22	156	420		1,252	5,390	4,370	3,373	1,626	6,423	12,494
8/17	0 [b]	0 [b]	[a]	0	0	1	0	1	2	16	156	420		1,252	5,390	4,371	3,373	1,627	6,425	12,510
8/18	0 [b]	0 [b]	[a]	0	7	0	2	1	3	10	156	420		1,252	5,397	4,371	3,375	1,628	6,428	12,520
8/19	0 [b]	1 [b]	[a]	0	4	0	0	1	5	12 [b]	156	421		1,252	5,401	4,371	3,375	1,629	6,433	12,532
8/20	0 [b]	0 [b]	[a]	1	3 [c]	1	4	0	0	10 [b]	156	421		1,253	5,404	4,372	3,379	1,629	6,433	12,542
8/21	0	1 [b]	[a]	0	3 [b]	0	2	0	7	9 [b]	156	422		1,253	5,407	4,372	3,381	1,629	6,440	12,550
8/22	0 [b]	0 [b]	[a]	0	3 [b]	0	0	0	0	7 [c]	156	422		1,253	5,410	4,372	3,381	1,629	6,440	12,557
8/23	0	0 [b]	[a]	0	0	1	5	0	1	3	156	422		1,253	5,410	4,373	3,386	1,629	6,440	12,560
8/24	0 [b]	0 [b]	[a]	0	1	1	0	0	6	8	156	422		1,253	5,411	4,374	3,386	1,629	6,446	12,568
8/25	0	0 [b]	[a]	0	2	2	1	0	0	2	156	422		1,253	5,413	4,376	3,387	1,629	6,446	12,570
8/26	0 [b]	0 [b]	[a]	0	0	0	0	0	0	4	156	422		1,253	5,413	4,376	3,387	1,629	6,446	12,574
8/27	0 [b]	0 [b]	[a]	0	0	0	0	0	2	4	156	422		1,253	5,413	4,376	3,387	1,629	6,448	12,578
8/28	0	0 [b]	[a]	0	1	0	1	0	2	5	156	422		1,253	5,414	4,376	3,388	1,629	6,450	12,583
8/29	0	0 [b]	[a]	1	0	0	0	0	0	4	156	422		1,254	5,414	4,376	3,388	1,629	6,450	12,587
8/30	0	0 [b]	[a]	0	0	0	0	0	1	4	156	422		1,254	5,414	4,376	3,388	1,629	6,451	12,591
8/31	0	0 [b]	[a]	0	0	1	1	0	1	2	156	422		1,254	5,414	4,377	3,389	1,629	6,452	12,593

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	Daily Passage										Cumulative Passage									
Date	**1995**	**1996**	**1997**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**1995**	**1996**	**1997**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
9/1	0	0 [b]	[a]	0	0	0	0	0	1	0	156	422		1,254	5,414	4,377	3,389	1,629	6,453	12,593
9/2	[a]	0 [b]	[a]	0	0	0	0	0	0	0		422		1,254	5,414	4,377	3,389	1,629	6,453	12,593
9/3	[a]	0 [b]	[a]	0	0	0	0	0	0	0		422		1,254	5,414	4,377	3,389	1,629	6,453	12,593
9/4	[a]	0 [b]	[a]	0	0	0	0	1	1	3		422		1,254	5,414	4,377	3,389	1,630	6,454	12,596
9/5	[a]	0 [b]	[a]	0	0	0	0	0	2	0		422		1,254	5,414	4,377	3,389	1,630	6,456	12,596
9/6	[a]	0 [b]	[a]	0	0	0	1	0	2	0		422		1,254	5,414	4,377	3,390	1,630	6,458	12,596
9/7	[a]	0 [b]	[a]	0	0	0	1	0	2	0		422		1,254	5,414	4,377	3,391	1,630	6,460	12,596
9/8	[a]	0 [b]	[a]	0	0	0	1	0	1	0		422		1,254	5,414	4,377	3,392	1,630	6,461	12,596
9/9	[a]	0 [b]	[a]	0	0	0	1	0	1	0		422		1,254	5,414	4,377	3,393	1,630	6,462	12,596
9/10	[a]	0 [b]	[a]	0	0	0	0	0	0	0		422		1,254	5,414	4,377	3,393	1,630	6,462	12,596
9/11	[a]	0 [b]	[a]	0	0	0	0	0	0	1		422		1,254	5,414	4,377	3,393	1,630	6,462	12,597
9/12	[a]	0 [b]	[a]	0	0	0	0	0	0	0		422		1,254	5,414	4,377	3,393	1,630	6,462	12,597
9/13	[a]	0 [b]	[a]	0	0	0	0	0	0	0		422		1,254	5,414	4,377	3,393	1,630	6,462	12,597
9/14	[a]	0 [b]	[a]	0	0	0	0	0	2	0		422		1,254	5,414	4,377	3,393	1,630	6,464	12,597
9/15	[a]	0 [b]	[a]	0	0 [b]	0	0	0	2	0		422		1,254		4,377	3,393	1,630	6,466	12,597
9/16	[a]	0 [b]	[a]	0	0 [b]	0	0	0	1	1		422		1,254		4,377	3,393	1,630	6,467	12,598
9/17	[a]	0 [b]	[a]	0	0 [b]	0	0	0	0	0		422		1,254		4,377	3,393	1,630	6,467	12,598
9/18	[a]	0 [b]	[a]	0	0 [b]	0	0	0	0	0		422		1,254		4,377	3,393	1,630	6,467	12,598
9/19	[a]	0 [b]	[a]	0	0 [b]	0	0	0 [b]	0	0		422		1,254		4,377	3,393	1,630	6,467	12,598
9/20	[a]	0 [b]	[a]	0	0 [b]	0	0	0 [b]	0	0		422		1,254		4,377	3,393	1,630	6,467	12,598

Note: The tower was operated for only 8 days in 1998; hence, that year is excluded from the table. The sum of daily passages might differ from the cumulative passage due to a rounding error.

[a] The weir or tower was not operational; daily passage was not estimated.

[b] The weir or tower was not operational; daily passage was estimated.

[c] Partial day count; passage was estimated.

Appendix A3.–Historical daily coho salmon escapement at the Takotna River weir during the current target operational period.

	Daily Passage							Cumulative Passage						
Date	2000	2001	2002	2003	2004	2005	2006	2000	2001	2002	2003	2004	2005	2006
6/24	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/25	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/26	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/27	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/28	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/29	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
6/30	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
7/01	0	0	0	0 [a]	0	0	0	0	0	0	0	0	0	0
7/02	0	0	0	0 [b]	0	0	0	0	0	0	0	0	0	0
7/03	0	0	0	0 [b]	0	0	0	0	0	0	0	0	0	0
7/04	0	0	0	0 [b]	0	0	0	0	0	0	0	0	0	0
7/05	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/06	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/07	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/08	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/09	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/11	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/14	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/16	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/17	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/18	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/19	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/20	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/21	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/24	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7/25	0	0	0	0	0	2	0	0	0	0	0	0	2	0
7/26	0	0	0	4	0	2	0	0	0	0	4	0	4	0
7/27	0	0	0	3	0	0	0	0	0	0	7	0	4	0
7/28	0	0	0	4 [c]	0	3	0	0	0	0	11	0	7	0
7/29	0	0	0	4 [c]	0	3	0	0	0	0	15	0	10	0
7/30	0	1	1	5 [c]	0	1	1	0	1	1	20	0	11	1
7/31	0	0	1	5 [c]	1	0	1	0	1	2	25	1	11	2
8/1	0	0	0	6 [d]	1	2	1	0	1	2	31	2	13	3
8/2	0	0	0	4	1	2	2	0	1	2	35	3	15	5
8/3	0	1	0	8	0	1	8	0	2	2	43	3	16	13
8/4	3	0	0	13	3	8	15	3	2	2	56	6	24	28
8/5	11	0	0	15	4	7	8	14	2	2	71	10	31	36
8/6	8	3	2	27	16	5	8	22	5	4	98	26	36	44
8/7	14	1	0	25	14	2	16	36	6	4	123	40	38	60
8/8	19	1	2	48	19	10	15	55	7	6	171	59	48	75
8/9	40	2	6	40	24	6	25	95	9	12	211	83	54	100
8/10	31	3	6	50	18	6	7	126	12	18	261	101	60	107
8/11	44	12	4	85	28	12	112	170	24	22	346	129	72	219

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	Daily Passage							Cumulative Passage						
Date	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**
8/12	80	19	26	139	78	10	40	250	43	48	485	207	82	259
8/13	42	20	27	150	20	19	53	292	63	75	635	227	101	312
8/14	51	29	23	212	61	20	31	343	92	98	847	288	121	343
8/15	58	31	36	140	60	22	74	401	123	134	987	348	143	417
8/16	54	51	49	131	92	14	118	455	174	183	1,118	440	157	535
8/17	98	44	20	121	182	18	175	553	218	203	1,239	622	175	710
8/18	146	77	159	160	124	57	121	699	295	362	1,399	746	232	831
8/19	192	66	17	348	56	22	159 [c]	891	361	379	1,747	802	254	990
8/20	80	91 [d]	11	197	74	25	170 [c]	971	452	390	1,944	876	279	1,161
8/21	387	91 [c]	266	356	57	26	182 [c]	1,358	543	656	2,300	933	305	1,342
8/22	178	91 [c]	326	254	61	27	193 [d]	1,536	634	982	2,554	994	332	1,535
8/23	241	74	328	176	88	111	125	1,777	708	1,310	2,730	1,082	443	1,660
8/24	152	145	397	189	57	258	283	1,929	853	1,707	2,919	1,139	701	1,943
8/25	107	156	301	217	137	204	290	2,036	1,009	2,008	3,136	1,276	905	2,233
8/26	86	275	267	299	572	114	111	2,122	1,284	2,275	3,435	1,848	1,019	2,344
8/27	314	175	107	429	73	84	232	2,436	1,459	2,382	3,864	1,921	1,103	2,576
8/28	490	151	134	335	44	69	231	2,926	1,610	2,516	4,199	1,965	1,172	2,807
8/29	140	164	121	288	74	102	138	3,066	1,774	2,637	4,487	2,039	1,274	2,945
8/30	120	104	127	219	46	163	235	3,186	1,878	2,764	4,706	2,085	1,437	3,180
8/31	62	137	205	267	37	55	115	3,248	2,015	2,969	4,973	2,122	1,492	3,295
9/1	70	105	133	285	398	80	231	3,318	2,120	3,102	5,258	2,520	1,572	3,526
9/2	66	92	107	277	330	21	155	3,384	2,212	3,209	5,535	2,850	1,593	3,681
9/3	54	71	63	192	70	47	126	3,438	2,283	3,272	5,727	2,920	1,640	3,807
9/4	70	73	90	91	11	106	104	3,508	2,356	3,362	5,818	2,931	1,746	3,911
9/5	46	68	118	262	20	85	74	3,554	2,424	3,480	6,080	2,951	1,831	3,985
9/6	100	26	134	209	3	82	254	3,654	2,450	3,614	6,289	2,954	1,913	4,239
9/7	42	13	109	188	6	59	132	3,696	2,463	3,723	6,477	2,960	1,972	4,371
9/8	25	14	79	200	23	45	328	3,721	2,477	3,802	6,677	2,983	2,017	4,699
9/9	30	14	39	131	18	37	164	3,751	2,491	3,841	6,808	3,001	2,054	4,863
9/10	36	15	19	70	192	40	105	3,787	2,506	3,860	6,878	3,193	2,094	4,968
9/11	40	11	21	78	0	31	119	3,827	2,517	3,881	6,956	3,193	2,125	5,087
9/12	27	24	37	83	0	26	66	3,854	2,541	3,918	7,039	3,193	2,151	5,153
9/13	29	12	13	79	0	16	65	3,883	2,553	3,931	7,118	3,193	2,167	5,218
9/14	16	15	14	28	9	17	61	3,899	2,568	3,945	7,146	3,202	2,184	5,279
9/15	9	6 [c]	16	10	3	13	41	3,908	2,574	3,961	7,156	3,205	2,197	5,320
9/16	15	11 [c]	7	9	2	13	54	3,923	2,585	3,968	7,165	3,207	2,210	5,374
9/17	5	3 [c]	7	4	0	4	48	3,928	2,588	3,975	7,169	3,207	2,214	5,422
9/18	8	5 [c]	2	1	0	0	42	3,936	2,593	3,977	7,170	3,207	2,214	5,464
9/19	10	6 [c]	2	1	0 [c]	0	43	3,946	2,599	3,979	7,171	3,207	2,214	5,507
9/20	11	7 [c]	5	0	0 [c]	2	41	3,957	2,606	3,984	7,171	3,207	2,216	5,548

Note: The tower was operated for only 8 days in 1998; hence, that year is excluded from the table. The sum of daily passages might differ from the cumulative passage due to rounding error.

[a] The weir was not operational; daily passage was not estimated.

[b] Partial day count; passage was not estimated.

[c] The weir was not operational; daily passage was estimated.

[d] Partial day count; passage was estimated.

APPENDIX B. PASSAGE OF OTHER SPECIES

Appendix B1.–Daily passage of sockeye and pink salmon and non-salmon species observed at the Takotna River weir, 2006.

Date	Sockeye Salmon	Pink Salmon	Longnose Sucker	Whitefish	Northern Pike
6/16	0	0	178	0	1
6/17	0	0	77	0	0
6/18	0	0	171	0	0
6/19	0	0	101	2	0
6/20	0	0	25	0	0
6/21	0	0	20	0	0
6/22	0	0	41	0	2
6/23	0	0	30	1	0
6/24	0	0	11	5	3
6/25	0	0	17	0	0
6/26	0	0	18	1	3
6/27	0	0	34	2	2
6/28	0	0	0	1	0
6/29	0	0	4	0	1
6/30	0	0	3	0	0
7/1	0	0	33	1	0
7/2	0	0	34	0	0
7/3	0	0	36	0	0
7/4	0	0	14	0	0
7/5	0	0	53	0	0
7/6	0	0	14	0	0
7/7	0	1	19	0	0
7/8	0	0	54	0	0
7/9	0	0	96	0	0
7/10	0	0	18	0	0
7/11	0	0	22	0	0
7/12	0	0	7	0	0
7/13	0	0	7	0	0
7/14	0	0	0	0	0
7/15	0	0	0	0	0
7/16	0	0	0	0	0
7/17	0	0	5	0	0
7/18	0	0	1	0	0
7/19	0	0	1	0	0
7/20	0	0	0	0	0
7/21	0	0	0	0	0
7/22	0	0	0	0	0
7/23	0	0	0	0	0
7/24	0	0	0	0	0
7/25	0	0	0	1	0
7/26	0	0	0	0	0
7/27	1	0	1	0	0
7/28	1	0	0	0	0
7/29	0	0	6	0	0
7/30	0	0	0	0	0
7/31	0	0	0	0	0
8/1	1	0	0	0	0
8/2	3	0	0	0	0
8/3	0	0	0	0	0
8/4	0	0	0	0	0
8/5	1	0	0	0	0
8/6	1	0	0	0	0
8/7	2	0	0	0	0
8/8	2	0	0	0	0
8/9	1	0	0	0	0
8/10	1	0	0	0	0

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Date	Sockeye Salmon	Pink Salmon	Longnose Sucker	Whitefish	Northern Pike
8/11	1	0	0	0	0
8/12	2	0	0	0	0
8/13	5	0	0	0	0
8/14	6	0	0	0	0
8/15	5	0	0	0	0
8/16	2	0	0	0	0
8/17	2	0	2	2	0
8/18	3	0	0	0	0
8/19 [a]	2	0	0	0	0
8/20 [a]	2	0	0	0	0
8/21 [a]	1	0	0	0	0
8/22 [b]	1	0	0	2	0
8/23	1	0	0	0	0
8/24	0	0	0	0	0
8/25	0	0	0	1	0
8/26	2	0	0	0	0
8/27	4	0	0	0	0
8/28	0	0	0	0	0
8/29	3	0	1	0	0
8/30	0	0	1	2	0
8/31	0	0	4	0	0
9/1	1	0	0	0	0
9/2	0	0	0	4	0
9/3	0	0	0	0	0
9/4	0	0	0	0	0
9/5	0	0	0	0	1
9/6	0	0	0	0	1
9/7	0	0	0	0	1
9/8	0	0	0	0	0
9/9	0	0	0	0	0
9/10	0	0	0	0	0
9/11	0	0	2	3	0
9/12	0	0	0	2	2
9/13	1	0	0	5	4
9/14	1	0	0	0	0
9/15	0	0	0	0	0
9/16	0	0	0	0	1
9/17	0	0	0	0	1
9/18	0	0	0	0	6
9/19	1	0	0	0	5
9/20	0	0	0	0	4
9/21	0	0	0	0	2
9/22	0	0	0	0	1
Total	60 [c]	1	1161	35	41

[a] The weir was not operational; daily passage was estimated for sockeye and pink salmon but not for the other listed species.

[b] Partial day count; daily passage was estimated for sockeye and pink salmon but not for the other listed species.

[c] Due to rounding error associated with estimates, the values in the "total" column are not necessarily the sum of the daily passages from the column above.

APPENDIX C. DAILY CARCASS COUNTS

Appendix C1.–Daily salmon carcass counts at the Takotna River weir, 2006.

	Chinook			Sockeye			Chum			Coho		
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
6/16	0	0	0	0	0	0	0	0	0	0	0	0
6/17	0	0	0	0	0	0	0	0	0	0	0	0
6/18	0	0	0	0	0	0	0	0	0	0	0	0
6/19	0	0	0	0	0	0	0	0	0	0	0	0
6/20	0	0	0	0	0	0	0	0	0	0	0	0
6/21	0	0	0	0	0	0	0	0	0	0	0	0
6/22	0	0	0	0	0	0	0	0	0	0	0	0
6/23	0	0	0	0	0	0	0	0	0	0	0	0
6/24	0	0	0	0	0	0	0	0	0	0	0	0
6/25	0	0	0	0	0	0	0	0	0	0	0	0
6/26	0	0	0	0	0	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0	0	0	0	0	0
6/29	0	0	0	0	0	0	1	0	1	0	0	0
6/30	0	0	0	0	0	0	0	0	0	0	0	0
7/1	0	0	0	0	0	0	0	1	1	0	0	0
7/2	0	0	0	0	0	0	0	0	0	0	0	0
7/3	0	0	0	0	0	0	0	1	1	0	0	0
7/4	0	0	0	0	0	0	0	0	0	0	0	0
7/5	0	0	0	0	0	0	1	0	1	0	0	0
7/6	0	0	0	0	0	0	0	0	0	0	0	0
7/7	0	0	0	0	0	0	5	5	10	0	0	0
7/8	0	0	0	0	0	0	3	0	3	0	0	0
7/9	0	0	0	0	0	0	2	0	2	0	0	0
7/10	0	0	0	0	0	0	0	0	0	0	0	0
7/11	0	0	0	0	0	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	4	1	5	0	0	0
7/13	0	0	0	0	0	0	3	2	5	0	0	0
7/14	0	0	0	0	0	0	3	2	5	0	0	0
7/15	0	0	0	0	0	0	5	4	9	0	0	0
7/16	0	0	0	0	0	0	1	1	2	0	0	0
7/17	0	0	0	0	0	0	8	1	9	0	0	0
7/18	0	0	0	0	0	0	1	0	1	0	0	0
7/19	0	0	0	0	0	0	7	3	10	0	0	0
7/20	0	0	0	0	0	0	9	1	10	0	0	0
7/21	0	0	0	0	0	0	3	4	7	0	0	0
7/22	0	0	0	0	0	0	2	4	6	0	0	0
7/23	0	0	0	0	0	0	2	0	2	0	0	0
7/24	1	0	1	0	0	0	9	3	12	0	0	0
7/25	0	0	0	0	0	0	6	1	7	0	0	0
7/26	0	0	0	0	0	0	7	4	11	0	0	0
7/27	0	0	0	0	0	0	7	1	8	0	0	0
7/28	1	0	1	0	0	0	6	2	8	0	0	0
7/29	0	0	0	0	0	0	6	2	8	0	0	0
7/30	0	0	0	0	0	0	11	1	12	0	0	0
7/31	0	0	0	0	0	0	11	3	14	0	0	0
8/1	1	0	1	0	0	0	8	0	8	0	0	0
8/2	0	0	0	0	0	0	7	2	9	0	0	0
8/3	2	0	2	0	0	0	8	2	10	0	0	0
8/4	4	0	4	0	0	0	8	4	12	0	0	0
8/5	2	0	2	0	0	0	10	6	16	0	0	0
8/6	1	0	1	0	0	0	4	3	7	0	0	0
8/7	1	0	1	0	0	0	4	3	7	0	0	0
8/8	1	0	1	0	0	0	8	3	11	0	0	0
8/9	0	0	0	0	0	0	2	1	3	0	0	0
8/10	1	1	2	0	0	0	11	4	15	0	0	0
8/11	0	0	0	0	0	0	6	1	7	0	0	0
8/12	2	0	2	0	0	0	7	2	9	0	0	0
8/13	1	0	1	0	0	0	8	4	12	0	0	0
8/14	2	0	2	0	0	0	5	2	7	0	0	0
8/15	0	0	0	0	0	0	8	4	12	0	0	0

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Appendix C1.–Page 2 of 2.

	Chinook			Sockeye			Chum			Coho		
Date	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
8/16	2	0	2	0	0	0	10	8	18	0	0	0
8/17	0	0	0	0	0	0	6	3	9	0	0	0
8/18	1	0	1	0	0	0	3	4	7	0	0	0
8/19[a]	0	0	0	0	0	0	0	0	0	0	0	0
8/20[a]	0	0	0	0	0	0	0	0	0	0	0	0
8/21[a]	0	0	0	0	0	0	0	0	0	0	0	0
8/22[a]	0	0	0	0	0	0	0	0	0	0	0	0
8/23	0	0	0	0	0	0	0	0	0	0	0	0
8/24	0	0	0	0	0	0	0	0	0	0	0	0
8/25	0	0	0	0	0	0	0	0	0	0	0	0
8/26	1	0	1	0	1	1	1	0	1	0	1	1
8/27	0	0	0	0	0	0	3	1	4	1	0	1
8/28	0	0	0	0	0	0	1	1	2	0	0	0
8/29	0	0	0	0	0	0	1	0	1	0	0	0
8/30	0	0	0	0	0	0	1	0	1	0	0	0
8/31	0	0	0	0	0	0	0	1	1	0	0	0
9/1	0	0	0	0	0	0	0	0	0	1	0	1
9/2	0	0	0	0	0	0	0	0	0	0	0	0
9/3	0	0	0	0	0	0	0	0	0	0	0	0
9/4	0	0	0	0	0	0	0	0	0	0	0	0
9/5	0	0	0	0	0	0	0	0	0	0	0	0
9/6	0	0	0	0	0	0	0	0	0	1	1	2
9/7	0	0	0	0	0	0	0	0	0	0	2	2
9/8	0	0	0	0	0	0	0	0	0	1	0	1
9/9	0	0	0	0	0	0	0	0	0	0	0	0
9/10	0	0	0	0	0	0	0	0	0	0	0	0
9/11	0	0	0	0	0	0	0	0	0	0	0	0
9/12	0	0	0	0	0	0	0	0	0	0	0	0
9/13	0	0	0	0	0	0	0	0	0	1	0	1
9/14	0	0	0	0	0	0	0	0	0	0	0	0
9/15	0	0	0	0	0	0	0	0	0	0	0	0
9/16	0	0	0	0	0	0	0	0	0	0	0	0
9/17	0	0	0	0	0	0	0	0	0	0	0	0
9/18	0	0	0	0	0	0	0	0	0	0	0	0
9/19	0	0	0	0	0	0	0	0	0	0	0	0
9/20	0	0	0	0	0	0	0	0	0	0	0	0
9/21	0	0	0	0	0	0	1	0	1	0	0	0
9/22	0	0	0	1	0	1	0	0	0	4	2	6
Totals:	24	1	**25**	1	1	**2**	254	106	**360**	9	6	**15**
Percent Female:			4.0%			50.0%			29.4%			40.0%

[a] Weir was mostly underwater and carcass counts are incomplete.

APPENDIX D. WEATHER AND STREAM OBSERVATIONS

Appendix D1.–Daily climate and water level data collected at the Takotna River weir site, 2006.

		Observations by Hour				Daily Totals
		Sky	Temperature		River	Precipitation
Date	Time	Code[a]	Air	Water	Stage (cm)	(mm)[b]
6/16	21:00	4	ND	ND	64	-
6/17	8:00	1	17.0	11.0	66	1.2
	21:00	1	18.1	14.0	71	
6/18	8:00	4	12.3	12.0	75	6.5
	21:00	4	13.0	12.2	73	
6/19	8:00	3	10.7	10.4	72	0.5
	17:00	4	18.7	11.8	74	
6/20	8:00	3	9.9	10.2	81	0.0
	17:00	3	19.4	11.7	81	
6/21	8:00	1	10.7	9.8	80	0.0
	17:00	2	19.7	12.3	77	
6/22	8:00	1	11.5	10.3	74	0.0
	17:00	1	20.8	14.3	72	
6/23	8:00	1	10.5	11.8	69	0.0
	17:00	3	20.6	13.4	69	
6/24	8:00	3	11.8	11.6	66	0.0
	17:00	3	21.0	14.2	65	
6/25	8:00	2	12.0	11.8	66	0.0
	17:00	3	25.0	14.8	66	
6/26	8:00	3	9.5	12.0	64	0.0
	17:00	3	21.5	13.5	64	
6/27	8:00	2	11.2	12.4	64	0.0
	17:00	2	22.1	15.6	63	
6/28	8:00	4	11.8	13.1	64	0.0
	17:00	2	20.0	14.1	62	
6/29	8:00	4	12.6	12.2	62	0.0
	17:00	4	13.1	13.1	61	
6/30	8:00	4	11.5	11.3	62	11.0
	17:00	4	14.9	12.4	64	
7/1	8:00	1	13.2	11.8	69	0.0
	17:00	3	23.8	14.0	69	
7/2	8:00	4	12.4	11.2	71	0.2
7/3	8:00	1	8.5	11.6	70	0.0
	17:00	2	26.5	15.5	64	
7/4	8:00	1	12.8	13.8	61	0.0
	17:00	2	27.0	15.8	61	
7/5	8:00	1	13.2	14.0	60	0.0
	17:00	1	24.2	18.5	59	
7/6	8:00	2	14.9	15.5	59	0.5
	16:00	4	16.2	16.5	59	
7/7	8:00	3	14.2	14.3	60	6.7
	20:00	3	16.3	15.0	62	
7/8	8:00	2	13.1	13.5	67	6.8
	17:00	2	20.8	14.5	74	
7/9	8:00	1	10.1	12.3	78	0.0
	17:00	2	26.8	14.6	76	
7/10	8:00	1	12.0	13.4	70	0.0
	17:00	3	30.2	16.4	69	
7/11	8:00	1	14.6	14.1	66	2.2
	17:00	3	23.1	16.5	66	
7/12	8:00	3	12.4	14.0	71	4.2
	17:00	3	22.0	15.4	70	
7/13	8:00	4	13.0	13.4	74	0.0
	17:00	3	20.1	14.1	76	

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		Observations by Hour				Daily Totals
		Sky	Temperature		River	Precipitation
Date	Time	Code[a]	Air	Water	Stage (cm)	(mm)[b]
7/14	8:00	4	11.6	11.9	69	0.4
	17:30	4	12.0	12.0	68	
7/15	8:00	4	10.6	10.8	68	1.2
	17:00	4	11.4	10.8	66	
7/16	8:30	4	11.7	9.5	69	11.7
	17:00	4	11.8	11.4	69	
7/17	8:00	4	10.7	9.1	84	0.0
	17:00	4	14.4	9.6	85	
7/18	8:00	4	11.2	8.7	81	0.0
	17:00	4	19.4	10.7	77	
7/19	8:00	4	12.5	10.3	76	0.0
	17:00	3	32.4	12.6	74	
7/20	8:00	1	9.2	11.9	70	0.0
7/21	8:00	2	10.1	12.6	66	0.0
	17:00	3	22.6	15.3	66	
7/22	8:00	3	13.7	13.3	66	0.0
	17:30	2	21.5	15.5	64	
7/23	8:00	1	10.1	12.3	70	1.5
	17:00	1	26.6	15.5	69	
7/24	8:00	3	13.2	13.5	64	0.0
	17:00	2	21.9	15.4	62	
7/25	8:00	3	13.3	13.1	62	0.0
	17:00	4	17.1	14.9	62	
7/26	8:00	4	13.5	12.8	60	6.1
	17:00	3	18.1	14.6	60	
7/27	8:00	2	9.2	12.9	64	0.0
	17:00	4	18.3	13.4	63	
7/28	9:00	3	11.5	11.7	64	0.0
	17:00	4	14.2	11.9	60	
7/29	8:00	4	10.7	10.6	60	2.2
	17:00	4	12.1	11.5	58	
7/30	8:00	4	9.9	9.7	58	0.0
	17:00	3	18.8	12.0	60	
7/31	8:00	4	9.2	10.4	60	0.3
	17:00	3	15.8	12.0	61	
8/1	8:00	4	9.8	10.3	61	2.5
	17:00	4	13.0	10.8	61	
8/2	8:00	4	9.9	9.7	61	2.2
	17:00	3	15.8	11.7	61	
8/3	8:30	3	9.9	10.3	61	0.3
	17:00	4	19.4	12.4	61	
8/4	8:00	4	10.7	10.6	60	0.5
	17:00	4	19.6	13.1	58	
8/5	8:30	5	9.8	11.2	57	0.0
	17:00	4	15.7	12.3	57	
8/6	8:00	5	7.0	10.6	58	0.0
	17:00	4	20.2	12.8	56	
8/7	8:00	3	11.4	11.7	58	0.0
	17:00	4	14.8	13.0	57	
8/8	8:00	4	11.9	11.5	56	0.0
	17:00	4	15.9	12.5	56	
8/9	8:00	4	10.9	11.2	54	0.0
	17:00	4	13.8	11.9	54	

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	Observations by Hour					Daily Totals
Date	Time	Sky Codes[b]	Air Temperature (°C)	Water Temperature (°C)	Water Stage (cm)	Precipitation (mm)[c]
8/10	8:00	4	12.4	10.7	54	2.2
	17:00	4	13.5	11.9	54	
8/11	8:00	4	12.2	10.5	55	5.1
	17:00	4	14.0	12.4	58	
8/12	8:00	4	12.0	10.5	62	7.4
	17:00	4	10.6	11.8	64	
8/13	8:00	4	8.6	9.9	69	0.4
	17:00	4	11.5	10.6	70	
8/14	8:00	4	10.2	9.5	67	2.8
	17:00	5	13.4	10.2	65	
8/15	8:00	5	11.9	9.6	69	15.2
	17:00	3	15.8	10.8	72	
8/16	8:00	3	10.6	10.0	79	0.0
	17:00	3	17.6	12.4	82	
8/17	8:00	3	11.5	10.0	82	2.0
	17:00	4	13.5	11.4	82	
	21:00	4	8.8	9.2	83	
8/18	8:00	4	8.8	9.2	83	35.2
	13:00	4	ND	ND	91	
	17:00	4	11.9	9.6	104	
8/19	8:00	2	4.8	7.9	135	4.0
	17:00	3	12.2	8.4	153	
8/20	8:00	5	0.3	6.7	141	0.0
	17:00	3	10.0	7.9	135	
8/21	8:00	3	3.6	5.8	108	2.0
	17:00	3	14.5	7.0	117	
8/22	8:00	4	7.2	6.6	110	2.6
	18:00	3	13.5	7.1	110	
8/23	9:00	4	9.0	6.5	115	3.0
	17:00	4	14.7	7.3	120	
8/24	9:00	5	6.7	6.4	114	3.1
	17:00	4	16.3	7.9	111	
8/25	8:00	4	8.3	7.3	100	5.0
	17:00	4	10.3	7.5	107	
8/26	8:00	4	9.9	6.9	107	3.6
	17:00	3	17.4	8.1	97	
8/27	8:00	2	4.3	6.6	97	0.0
	17:00	3	16.1	8.2	97	
8/28	9:00	5	3.9	6.8	90	0.0
	17:00	3	15.7	8.2	87	
8/29	8:30	3	7.9	7.1	85	0.0
	17:00	3	19.2	6.2	84	
8/30	8:30	4	8.5	7.7	82	0.0
	17:00	4	19.1	8.9	81	
8/31	8:30	2	6.1	7.3	79	0.0
	17:00	4	14.8	8.6	77	
9/1	9:00	4	7.7	7.5	76	0.8
	17:00	2	18.6	9.0	74	
9/2	9:00	4	6.7	6.4	73	0.0
	17:00	3	16.9	8.6	73	
9/3	9:00	1	1.8	6.1	71	0.0
	17:00	1	28.4	8.8	70	

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	Observations by Hour					Daily Totals
Date	Time	Sky Codes[b]	Air Temperature (°C)	Water Temperature (°C)	Water Stage (cm)	Precipitation (mm)[c]
9/4	9:00	1	1.4	6.2	69	0.0
	17:00	1	21.3	8.8	69	
9/5	9:00	1	2.2	6.6	67	0.0
	17:00	2	18.1	8.7	67	
9/6	9:00	5	7.0	7.7	66	0.0
	17:00	1	15.9	9.0	65	
9/7	9:00	4	10.2	7.5	65	0.0
	17:00	4	12.3	7.7	65	
9/8	9:00	2	8.2	7.6	64	9.0
	17:00	3	17.2	9.7	64	
9/9	9:00	4	7.0	7.4	66	0.0
	17:00	4	13.5	8.4	66	
9/10	9:00	5	5.2	7.0	64	0.4
	17:00	2	22.3	9.8	62	
9/11	9:00	3	5.1	7.2	62	0.3
	17:00	3	16.6	8.6	62	
9/12	9:00	5	6.9	7.2	62	0.0
	17:00	2	18.6	9.5	60	
9/13	9:00	5	2.0	6.5	60	0.0
	17:00	2	21.0	9.5	61	
9/14	9:00	4	10.2	7.7	59	0.6
	17:00	4	13.2	8.4	59	
9/15	9:00	3	9.7	7.5	61	3.0
	17:00	4	16.7	8.9	61	
9/16	9:00	3	6.6	7.8	63	0.0
	17:00	4	14.4	8.1	63	
9/17	9:00	3	7.1	6.6	61	0.0
	17:00	3	14.3	8.9	60	
9/18	8:30	2	4.1	7.7	58	0.0
	17:00	3	17.4	9.1	57	
9/19	8:30	3	4.2	7.3	56	0.0
	17:00	2	21.2	9.9	56	
9/20	8:30	3	6.8	7.7	56	0.0
	17:00	4	12.9	9.1	55	
9/21	8:30	5	7.8	8.4	55	5.6
	17:00	3	13.2	8.5	55	
9/22	8:30	4	7.8	7.8	56	0.8
	17:00	3	9.3	7.9	57	
		Minimum:	0.3	5.8	54.0	0.0
		Maximum:	32.4	18.5	153.0	35.2
		Average:[d]	13.6	10.7	70.9	1.9

Note: ND = no data

[a] Averages are calculated from the 8:00- 9:00 and the 16:00- 18:00 observations. Averages were not computed if no observations were made during one of these times.

[b] Sky Codes: 0 = no observation

1 = clear or mostly clear (<10% cloud cover)

2 = cloud cover less than 50% of the sky

3 = cloud cover more than 50% of the sky

4 = complete overcast

[c] Represents cumulative precipitation in the previous 24 hours.

[d] Includes only days with a morning observation between 0800 and 0900 hrs and an afternoon observation between 1700 and 2100 hours. On the rare occasion that two observations were made during the afternoon range of time, the observation closest to 1700 hrs was used.

APPENDIX E. JUVENILE SAMPLING EVENTS

Appendix E1.–Summary of juvenile sampling events, 2006.

			Number Caught											
Sampling Date	Index Area[a]	Gear Type	Chinook	Coho	Chum	Arctic Grayling	Blackfish	Burbot	Dolly Varden	Lamprey	Northern pike	Sculpin	Longnose Suckers	Whitefish
2-Jun	11	Minnow Trap	0	0	0	0	0	1	0	0	0	0	0	0
2-Jun	11	Minnow Trap	0	0	0	0	0	3	0	0	0	1	0	0
3-Jun	11	Minnow Trap	0	0	0	0	0	3	0	0	0	1	0	0
3-Jun	11	Minnow Trap	0	0	0	0	1	2	0	0	0	6	0	0
4-Jun	10	Minnow Trap	0	0	0	0	0	0	0	0	0	1	0	0
4-Jun	10	Minnow Trap	0	0	0	0	0	0	0	0	0	1	0	0
16-Sep	5	Minnow Trap	0	0	0	0	0	0	0	0	0	1	0	0
16-Sep	5	Minnow Trap	0	0	0	0	0	5	0	0	0	3	0	0
16-Sep	7	Minnow Trap	0	0	0	0	0	0	0	0	0	1	0	0

[a] See Figure 4 for description of Index Areas.

APPENDIX F. HISTORICAL CUMULATIVE PERCENT SALMON PASSAGE

Appendix F1.–Historical daily cumulative percent passage of Chinook salmon at the Takotna River tower (1995–1998) and weir (2000–2006).

Date	1996[a]	1997	2000	2001[a]	2002	2003[ab]	2004	2005	2006[a]
6/24	0	1	0	0	0		0	0	0
6/25	0	4	1	1	0		1	0	0
6/26	2	6	1	1	0		1	1	0
6/27	6	6	1	1	1		3	2	0
6/28	8	9	1	1	2		6	6	0
6/29	14	12	2	2	3		7	9	1
6/30	18	17	2	3	3		11	19	1
7/01	22	17	2	6	5		11	19	1
7/02	25	20	6	6	5	3	11	19	2
7/03	28	26	11	9	5	4	12	19	2
7/04	46	32	12	11	6	4	17	21	4
7/05	56	36	16	11	7	6	18	24	6
7/06	58	41	18	11	10	7	22	28	8
7/07	67	44	21	13	16	9	23	31	11
7/08	73	49	32	29	26	11	28	35	16
7/09	74	55	35	31	28	21	59	37	25
7/10	75	59	36	41	29	27	63	45	31
7/11	76	65	38	42	58	30	66	49	35
7/12	78	69	44	46	74	34	69	52	39
7/13	79	71	45	52	75	40	70	64	42
7/14	81	77	46	56	76	42	73	67	45
7/15	83	79	47	62	76	42	76	67	45
7/16	83	80	48	66	76	44	78	76	45
7/17	88	83	48	68	77	46	79	79	49
7/18	91	87	50	70	79	52	81	80	51
7/19	93	88	51	74	80	59	81	84	59
7/20	95	90	54	78	83	66	82	85	70
7/21	97	90	56	81	84	68	83	85	78
7/22	98	91	67	84	85	72	83	86	80
7/23	99	92	68	86	85	73	89	87	82
7/24	100	93	69	88	85	76	89	88	83
7/25	100	95	74	90	87	78	89	89	84
7/26	100	96	75	91	89	79	91	91	85
7/27	100	97	77	92	89	81	92	92	86
7/28	100	98	79	94	90	83	92	93	87
7/29	100	99	81	94	92	85	93	94	88
7/30	100	99	83	94	94	86	95	94	89
7/31	100	99	83	95	94	88	95	95	91
8/1	100	99	84	95	94	89	95	95	91
8/2	100	100	84	95	94	90	95	95	93
8/3	100	100	86	95	94	91	95	95	95
8/4	100	100	88	96	95	93	96	95	96
8/5	100	100	90	96	95	94	97	96	96
8/6	100	100	91	96	95	94	97	97	96
8/7	100	100	91	97	96	94	98	97	97
8/8	100	100	93	97	96	96	98	97	97
8/9	100	100	95	97	97	96	98	97	97
8/10	100	100	95	97	97	96	98	97	98
8/11	100	100	96	98	97	96	98	97	98
8/12	100	100	98	98	98	96	98	97	98

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Date	1996[a]	1997	2000	2001[a]	2002	2003[ab]	2004	2005	2006[a]
8/13	100	100	99	98	99	96	99	98	98
8/14	100	100	99	98	99	97	99	98	98
8/15	100	100	99	98	99	97	99	98	99
8/16	100	100	99	98	99	97	99	98	99
8/17	100	100	99	98	99	97	99	98	99
8/18	100	100	99	98	99	98	99	98	99
8/19	100	100	99	98	99	98	99	98	99
8/20	100	100	99	98	99	98	100	98	99
8/21	100	100	99	99	99	98	100	98	99
8/22	100	100	99	99	99	98	100	98	99
8/23	100	100	99	99	99	99	100	98	100
8/24	100	100	99	99	99	99	100	98	100
8/25	100	100	99	99	99	99	100	99	100
8/26	100	100	99	99	99	99	100	99	100
8/27	100	100	100	99	99	100	100	99	100
8/28	100	100	100	99	99	100	100	99	100
8/29	100	100	100	99	99	100	100	99	100
8/30	100	100	100	100	99	100	100	99	100
8/31	100	100	100	100	99	100	100	99	100
9/1	100	100	100	100	99	100	100	99	100
9/2	100	100	100	100	99	100	100	99	100
9/3	100	100	100	100	99	100	100	99	100
9/4	100	100	100	100	99	100	100	100	100
9/5	100	100	100	100	99	100	100	100	100
9/6	100	100	100	100	99	100	100	100	100
9/7	100	100	100	100	99	100	100	100	100
9/8	100	100	100	100	99	100	100	100	100
9/9	100	100	100	100	99	100	100	100	100
9/10	100	100	100	100	99	100	100	100	100
9/11	100	100	100	100	99	100	100	100	100
9/12	100	100	100	100	99	100	100	100	100
9/13	100	100	100	100	100	100	100	100	100
9/14	100	100	100	100	100	100	100	100	100
9/15	100	100	100	100	100	100	100	100	100
9/16	100	100	100	100	100	100	100	100	100
9/17	100	100	100	100	100	100	100	100	100
9/18	100	100	100	100	100	100	100	100	100
9/19	100	100	100	100	100	100	100	100	100
9/20	100	100	100	100	100	100	100	100	100

Note: The boxes represent the median passage date and central 50% of the run. The weir was not operational for most of the target operational period in 1995 and 1998; hence, those years are excluded from the table.

[a] Includes estimates for inoperable periods and/or breaches in the weir.

[b] Estimates were not made for the late start date in 2003; as a result, cumulative percent passage may be skewed late.

Appendix F2.–Historical daily cumulative percent passage of chum salmon at the Takotna River tower (1995–1998) and weir (2000–2006).

Date	1996[a]	1997	2000	2001[a]	2002[a]	2003[a]	2004	2005	2006[a]
6/24	4	1	0	0	1	0	0	0	0
6/25	4	2	2	0	2	0	1	0	0
6/26	4	3	4	0	3	0	3	0	1
6/27	8	6	5	1	6	0	4	0	1
6/28	10	8	5	1	8	0	6	1	2
6/29	15	13	6	1	12	1	8	1	2
6/30	19	16	6	1	16	1	10	1	4
7/01	22	17	7	2	20	1	13	2	5
7/02	25	19	9	3	21	2	16	2	6
7/03	28	20	10	4	25	4	20	3	9
7/04	33	24	13	4	27	6	23	5	11
7/05	42	28	14	5	32	9	26	8	14
7/06	52	33	18	6	37	12	33	11	19
7/07	61	35	21	8	43	16	37	16	24
7/08	68	37	29	11	46	20	41	22	27
7/09	74	41	33	13	48	24	46	25	31
7/10	78	44	35	16	53	27	52	30	35
7/11	81	48	40	20	59	28	56	33	39
7/12	83	49	42	27	65	31	61	37	42
7/13	86	51	46	32	67	32	62	40	46
7/14	86	58	50	38	69	37	64	43	50
7/15	87	60	53	43	71	40	66	47	53
7/16	88	63	56	47	73	45	67	51	57
7/17	90	67	60	51	76	49	71	58	60
7/18	92	71	62	56	78	54	77	62	63
7/19	94	72	67	63	81	60	78	68	66
7/20	95	73	71	68	84	67	81	73	69
7/21	95	77	74	72	85	71	82	75	73
7/22	96	79	79	76	88	76	83	79	75
7/23	97	82	81	79	89	79	87	81	77
7/24	97	86	83	82	91	81	89	83	80
7/25	97	87	85	85	92	83	90	85	82
7/26	98	88	87	87	94	84	91	87	84
7/27	98	92	88	89	94	86	92	89	86
7/28	99	93	89	91	95	87	93	91	88
7/29	99	96	90	92	96	89	94	93	89
7/30	99	98	91	93	97	90	95	94	90
7/31	99	99	92	95	97	91	96	95	91
8/1	99	100	92	95	97	92	97	95	92
8/2	100	100	93	96	98	93	98	96	93
8/3	100	100	93	97	98	94	98	96	95
8/4	100	100	95	97	99	95	98	97	96
8/5	100	100	95	98	99	96	98	97	96
8/6	100	100	96	98	99	97	99	98	97
8/7	100	100	97	99	99	98	99	98	97
8/8	100	100	98	99	99	98	99	98	98
8/9	100	100	98	99	99	98	99	99	98
8/10	100	100	99	99	99	98	99	99	98
8/11	100	100	99	99	100	98	99	99	98
8/12	100	100	100	99	100	99	100	99	98

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Date	1996[a]	1997	2000	2001[a]	2002[a]	2003[a]	2004	2005	2006[a]
8/13	100	100	100	99	100	99	100	99	99
8/14	100	100	100	100	100	99	100	99	99
8/15	100	100	100	100	100	99	100	99	99
8/16	100	100	100	100	100	99	100	99	99
8/17	100	100	100	100	100	99	100	99	99
8/18	100	100	100	100	100	99	100	99	99
8/19	100	100	100	100	100	99	100	99	99
8/20	100	100	100	100	100	100	100	99	100
8/21	100	100	100	100	100	100	100	100	100
8/22	100	100	100	100	100	100	100	100	100
8/23	100	100	100	100	100	100	100	100	100
8/24	100	100	100	100	100	100	100	100	100
8/25	100	100	100	100	100	100	100	100	100
8/26	100	100	100	100	100	100	100	100	100
8/27	100	100	100	100	100	100	100	100	100
8/28	100	100	100	100	100	100	100	100	100
8/29	100	100	100	100	100	100	100	100	100
8/30	100	100	100	100	100	100	100	100	100
8/31	100	100	100	100	100	100	100	100	100
9/1	100	100	100	100	100	100	100	100	100
9/2	100	100	100	100	100	100	100	100	100
9/3	100	100	100	100	100	100	100	100	100
9/4	100	100	100	100	100	100	100	100	100
9/5	100	100	100	100	100	100	100	100	100
9/6	100	100	100	100	100	100	100	100	100
9/7	100	100	100	100	100	100	100	100	100
9/8	100	100	100	100	100	100	100	100	100
9/9	100	100	100	100	100	100	100	100	100
9/10	100	100	100	100	100	100	100	100	100
9/11	100	100	100	100	100	100	100	100	100
9/12	100	100	100	100	100	100	100	100	100
9/13	100	100	100	100	100	100	100	100	100
9/14	100	100	100	100	100	100	100	100	100
9/15	100	100	100	100	100	100	100	100	100
9/16	100	100	100	100	100	100	100	100	100
9/17	100	100	100	100	100	100	100	100	100
9/18	100	100	100	100	100	100	100	100	100
9/19	100	100	100	100	100	100	100	100	100
9/20	100	100	100	100	100	100	100	100	100

Note: The boxes represent the median passage date and central 50% of the run. The weir was not operational for most of the target operational period in 1995 and 1998; hence, those years are excluded from the table.

[a] Includes estimates for inoperable periods and/or breaches in the weir.

Appendix F3.–Historical daily cumulative percent passage of coho salmon at the Takotna River weir (2000–2006).

Date	2000	2001[a]	2002	2003[a]	2004	2005	2006[ab]
6/24	0	0	0	0	0	0	0
6/25	0	0	0	0	0	0	0
6/26	0	0	0	0	0	0	0
6/27	0	0	0	0	0	0	0
6/28	0	0	0	0	0	0	0
6/29	0	0	0	0	0	0	0
6/30	0	0	0	0	0	0	0
7/01	0	0	0	0	0	0	0
7/02	0	0	0	0	0	0	0
7/03	0	0	0	0	0	0	0
7/04	0	0	0	0	0	0	0
7/05	0	0	0	0	0	0	0
7/06	0	0	0	0	0	0	0
7/07	0	0	0	0	0	0	0
7/08	0	0	0	0	0	0	0
7/09	0	0	0	0	0	0	0
7/10	0	0	0	0	0	0	0
7/11	0	0	0	0	0	0	0
7/12	0	0	0	0	0	0	0
7/13	0	0	0	0	0	0	0
7/14	0	0	0	0	0	0	0
7/15	0	0	0	0	0	0	0
7/16	0	0	0	0	0	0	0
7/17	0	0	0	0	0	0	0
7/18	0	0	0	0	0	0	0
7/19	0	0	0	0	0	0	0
7/20	0	0	0	0	0	0	0
7/21	0	0	0	0	0	0	0
7/22	0	0	0	0	0	0	0
7/23	0	0	0	0	0	0	0
7/24	0	0	0	0	0	0	0
7/25	0	0	0	0	0	0	0
7/26	0	0	0	0	0	0	0
7/27	0	0	0	0	0	0	0
7/28	0	0	0	0	0	0	0
7/29	0	0	0	0	0	0	0
7/30	0	0	0	0	0	0	0
7/31	0	0	0	0	0	0	0
8/1	0	0	0	0	0	1	0
8/2	0	0	0	0	0	1	0
8/3	0	0	0	1	0	1	0
8/4	0	0	0	1	0	1	1
8/5	0	0	0	1	0	1	1
8/6	1	0	0	1	1	2	1
8/7	1	0	0	2	1	2	1
8/8	1	0	0	2	2	2	1
8/9	2	0	0	3	3	2	2
8/10	3	0	0	4	3	3	2
8/11	4	1	1	5	4	3	4
8/12	6	2	1	7	6	4	5

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Date	2000	2001[a]	2002	2003[a]	2004	2005	2006[ab]
8/13	7	2	2	9	7	5	6
8/14	9	4	2	12	9	5	6
8/15	10	5	3	14	11	6	8
8/16	11	7	5	16	14	7	10
8/17	14	8	5	17	19	8	13
8/18	18	11	9	20	23	10	15
8/19	23	14	10	24	25	11	18
8/20	25	17	10	27	27	13	21
8/21	34	21	16	32	29	14	24
8/22	39	24	25	36	31	15	28
8/23	45	27	33	38	34	20	30
8/24	49	33	43	41	36	32	35
8/25	51	39	50	44	40	41	40
8/26	54	49	57	48	58	46	42
8/27	62	56	60	54	60	50	46
8/28	74	62	63	59	61	53	51
8/29	77	68	66	63	64	57	53
8/30	81	72	69	66	65	65	57
8/31	82	77	75	69	66	67	59
9/1	84	81	78	73	79	71	64
9/2	86	85	81	77	89	72	66
9/3	87	88	82	80	91	74	69
9/4	89	90	84	81	91	79	70
9/5	90	93	87	85	92	83	72
9/6	92	94	91	88	92	86	76
9/7	93	95	93	90	92	89	79
9/8	94	95	95	93	93	91	85
9/9	95	96	96	95	94	93	88
9/10	96	96	97	96	100	94	90
9/11	97	97	97	97	100	96	92
9/12	97	98	98	98	100	97	93
9/13	98	98	99	99	100	98	94
9/14	99	99	99	100	100	99	95
9/15	99	99	99	100	100	99	96
9/16	99	99	100	100	100	100	97
9/17	99	99	100	100	100	100	98
9/18	99	100	100	100	100	100	98
9/19	100	100	100	100	100	100	99
9/20	100	100	100	100	100	100	100

Note: The boxes represent the median passage date and central 50% of the run.

[a] Includes estimates for inoperable periods and/or breaches in the weir.

[b] Known to be an underestimate of total annual coho salmon passage because passage had not dramatically decreased during the last 10 days of operation, including the 2 days the weir remained operating after the target completion date of 20 September. Thus, the reported cumulative percent passage is probably skewed early.